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ENGINEERING:

An Illustrated Weekly Journal.

EDITED BY CHAS. COOPER AND J. FOSTER PETREE.

OFFICES FOR ADVERTISEMENTS AND PUBLICATION, 35 & 36, BEDFORD ST., STRAND, LONDON, W.C.2.

VOL. 164—No. 4259 *Registered at the General Post Office as a Newspaper* *LONDON: FRIDAY, SEPTEMBER 12, 1947.* PRICE 1s. 6d. POSTAGE { INLAND 2½d. FOREIGN 3d.

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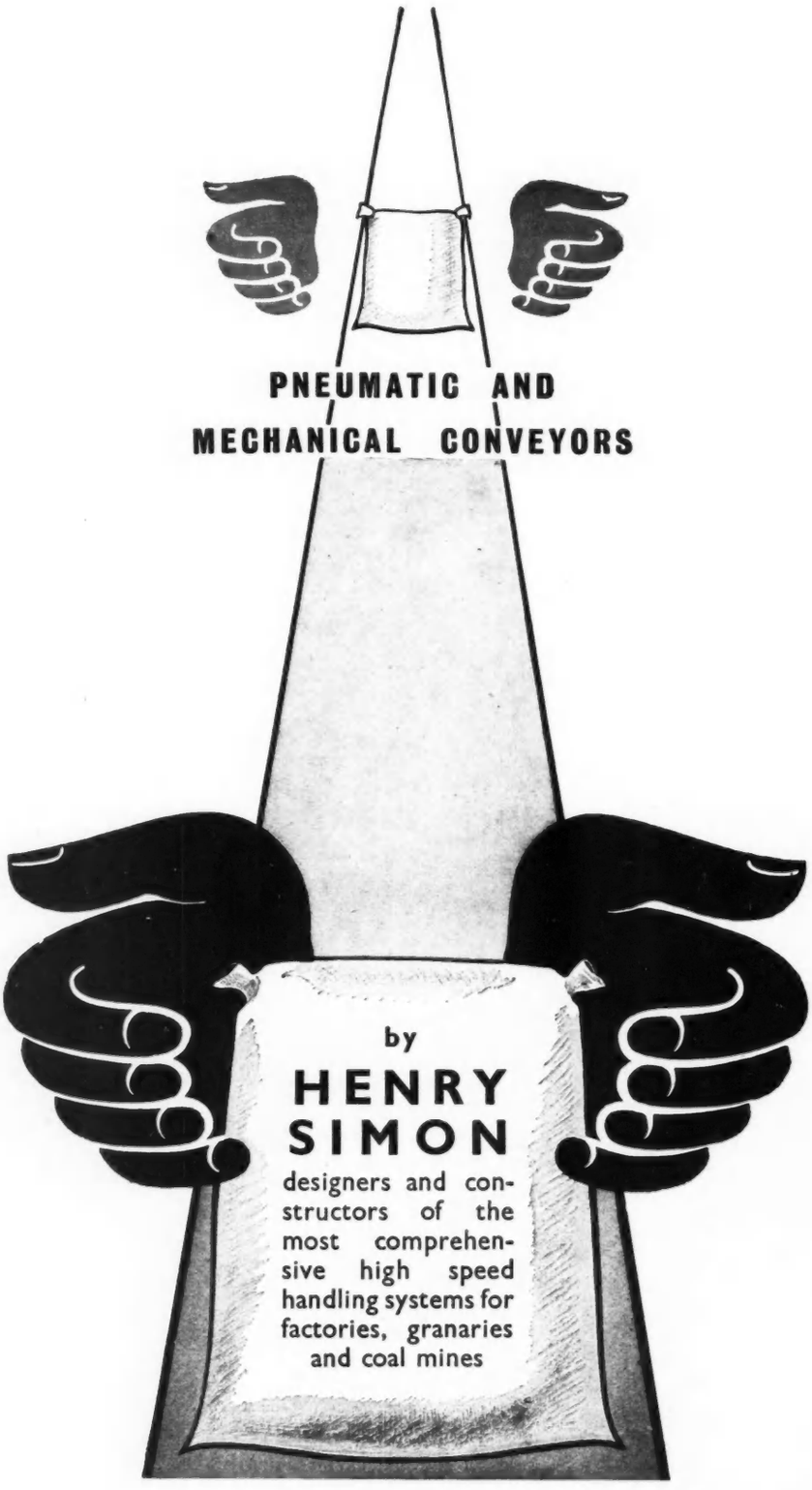
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ENGINEERING AND MARINE EXHIBITION AT OLYMPIA,

INCORPORATING THE FOUNDRY TRADES' AND WELDING EXHIBITIONS.

(*Continued from page* 225.)

THE loading, stacking and tiering truck illustrated in Figs. 49 and 50, below, is being shown on the stand of Messrs. Electro-Hydraulics, Limited, Liverpool-road, Warrington. Known as the "Conveyancer" fork-lift truck, Mark I, it will lift a load of 2 tons to a height of 9 ft. in 15 seconds; has a maximum road speed, both forward and reverse, of approximately 10 m.p.h.; and has a minimum outside turning radius of 8 ft. 6 in., with an inside turning radius of 25¾ in. It will be clear from Fig. 49 that the truck has a pair of forks, normally about 2 ft. long, attached to a carriage which is raised on a tilting frame. The lifting mechanism consists of a single hydraulic ram, the crosshead of which carries a pair of pulleys over which are passed roller chains, one end of the chains being attached to the fork carriage while the other end is anchored to the tilting frame. This multiplying arrangement gives the 9-ft. lift, although the stroke of the ram is only 4 ft. 6 in. The frame can be tilted backwards to an inclination from the vertical of 10 deg., and forwards to an inclination of 3 deg. The forward tilt brings the tips of the forks into contact with the ground for insertion under the load, the backward tilt ensuring stability when travelling by the shifting of the centre of gravity. This stability is well illustrated in Fig. 50, in which a heavy load of filled sacks is about to be deposited on a stack. The time required to effect tilting is about 3 seconds and the operation is effected by a pair of hinged hydraulic jacks, one of which can be seen in Fig. 49.

The truck is carried on four wheels with solid-rubber tyres, the front pair of which are the steering wheels and the back pair driving wheels; contact with the road of all four wheels is ensured by swivelled transverse springing. The wheel gauge is 3 ft. 2⅛ in., and the wheelbase 4 ft. 9 in. The overall dimensions are: length, with 2 ft. forks, 9 ft. 2¼ in.; width, 4 ft.; height, with forks on the ground, 6 ft. 7 in., and with forks fully raised, 11 ft. 1 in. Steering is effected by a handwheel, and braking by Girling brakes on the driving wheels, the brakes having both hand and pedal control. The power unit, which is well protected, consists of a side-valve petrol engine developing 30 brake horse-power at the governed speed of 2,000 r.p.m., this engine having a R.A.C. rating of 14 h.p. It is directly-coupled to a continuous-current generator and also drives a rotary-type hydraulic pump through a chain. The generator supplies current to a motor which is connected, by means of a flexible coupling, to a double-reduction gear having a ratio of 15 to 1, on the driving axle. A 12-volt electric starting and lighting equipment is included. We have had an opportunity of witnessing tests of the truck elsewhere than at the exhibition, and noticed that the electric drive appeared to give smooth acceleration, while the infinitely-variable speed range it provides assists the operation of manœuvring the truck into position. The manipulation of the loading and handling mechanism is simple. Two selectors are fitted for control of the hydraulic rams. One of these effects lifting and lowering of the forks, the other controls the tilting of the frame; when both selectors are in the neutral position the pump is automatically unloaded. The truck, unloaded, weighs just over 66 cwt., and can be readily used for towing transporter trucks.

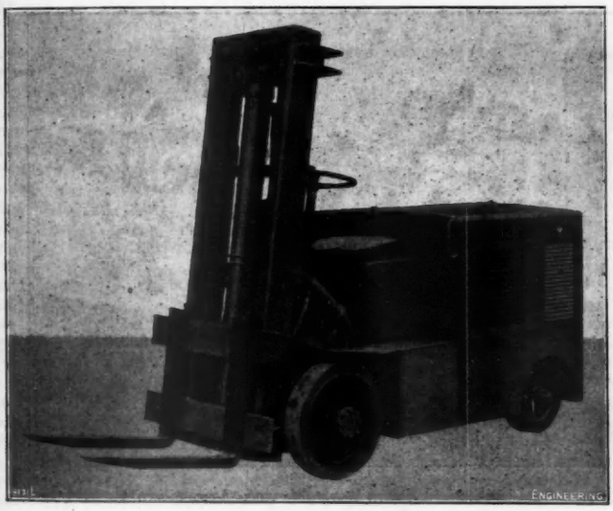


FIG. 49.

FIG. 50.

FIGS. 49 and 50. 2-TON "CONVEYANCER" STACKING TRUCK; MESSRS. ELECTRO-HYDRAULICS, LIMITED.

Since the organisation known as Associated British Oil Engines, Limited, Duke's-court, 32, Duke-street, St. James's, London, S.W.1, are the sole concessionaires for the distribution of six different makes of oil engine, it was to be expected that the display on their stand would cover a wide variety. It is not practicable to deal in detail with all of the exhibits here, but three of them are illustrated in Figs. 51 to 53, page 242. The engine shown in Fig. 51, and notable, among other things, for the effective enclosure of its working parts, is the new 12-cylinder direct air-reversing V-type engine, "T.V. 12," developed by Messrs. Mirrlees, Bickerton and Day, Limited, Hazel Grove, near Stockport. The engine has two banks of six cylinders each mounted on a new form of crankcase with their centre lines at an included angle of 35 deg., which arrangement results in an overall top width little greater than that of the bedplate. The cylinders are of 8¼ in. bore by 13½ in. stroke, and the engine is rated at 540 shaft horse-power at 500 r.p.m., or 630 shaft horse-power at 600 r.p.m. These outputs are with normal aspiration, but when an exhaust turbo-charger is fitted the ratings are increased to 684 shaft horse-power at 500 r.p.m., or to 820 shaft horse-power at 600 r.p.m. The engine can be fitted with a 2 to 1 reduction gear or constructed as a non-reversing engine with reverse reduction gear. It is thus suitable for marine use, but it is also constructed for industrial applications, and the following description applies mainly to that type. With normal aspiration the industrial type engine gives an output of 720 brake horse-power, and, with supercharging, one of 1,050 brake horse-power, the speed ranging from 500 r.p.m. to 750 r.p.m. The specific fuel consumption for the industrial engine with normal aspiration is given as 0·375 lb. per brake horse-power per hour.

The bedplate is fitted with seven crankshaft bearings, and all oil passages are either drilled or cast in it. The main bearings have steel shells with white-metal liners and are located in the caps so that they can be removed without disturbing the camshaft. The buffer-like projection seen on the bedplate near the flywheel is one of the lifting lugs provided so that the engine can be handled complete without affecting any fittings. A column on the bedplate carries the separate cylinders, which have wet liners. The heads are also separate and there are two air valves and two exhaust valves per cylinder; two springs are used for each valve and the valve gear is operated by two push rods. The heads, of course, are water-jacketed and the fuel injector is centrally disposed. There is an individual Bryce fuel pump to each injector; they are readily accessible by removing light Bakelite covers, the tops of which are identifiable in Fig. 51, by the reflections of the pressure gauges fitted above them. The fuel is passed through an Auto-Klean strainer prior to reaching the pumps and all fuel leakage is

collected in a drain tank to prevent it from contaminating the lubricating oil. The oil is supplied from the sump by a gearwheel-type pump driven directly from the crankshaft and passes through a dual Lolos strainer and tubular oil cooler. The working oil pressure is between 20 lb. and 25 lb. per square inch, and an automatic device stops the engine should this pressure fall below 7 lb. per square inch. The piston and gudgeon pins are splash-lubricated. The pistons are of "Y" alloy and are fitted with three compression and two scraper rings. The connecting rods are H-section stampings of 40-ton steel. The crankshaft is made from a 0·40-per cent. carbon-steel forging hardened and tempered to B.S. En 12 and machined all over. The crank webs are of oval contour to give the required torsional strength and to reduce the weight in the region of the crankpins. The centrifugal loading on the bearings due to the revolving masses is relatively low, while the natural frequency of the torsional vibrations is high enough to keep the engine free from serious critical speeds in the running range.

A sensitive governor is fitted, having four weights on ball-bearing pivots; it is driven by bevel gears from one of the two valve camshafts; handwheel speed control is fitted. An overspeed governor, entirely independent of the main governor, is also driven from the camshaft, and stops the engine in case of excessive speed. The engine is started by compressed air derived from a separately-driven compressor and stored in a receiver of about 11 cub. ft. capacity at a pressure of 300 lb. per square inch. Compressed air is admitted to each cylinder of one bank by means of a master valve and distributor valves incorporated in the fuel-pump tappet block. Air is thus passed in the correct sequence to automatic spring-loaded valves in the cylinder heads. The engine will start from any position, by the movement of one hand lever at the control position, without barring, but, clearly, when starting from dead cold a couple of revolutions barring is desirable in order to distribute the oil film in the bearings supplied by the lubricating-oil hand pump.

The self-contained Diesel-electric generating set illustrated in Fig. 52 is one of the 1,500 sets for which material has been allocated by the Ministry of Supply for what is regarded as emergency use. These sets are being produced by Associated British Oil Engines, Limited, in conjunction with the Brush Electrical Engineering Company, Limited, Loughborough. The engine is manufactured by Messrs. J. and K. McLaren, Limited, Hunslet, Leeds, 10, and is of that firm's "MR.4" four-cylinder four-cycle airless-injection type, developing 88 brake horse-power when running at 1,000 r.p.m. The speed can be regulated from the switchboard seen on the left. There is a large radiator with a belt-driven fan and a water-circulating pump. The cylinder seen in the centre of the set is a fuel tank holding 30 gallons, which is sufficient fuel to run the set at full load for eight hours. Starting is by compressed air delivered from a Petter-Reavell compressor, not visible, to the receiver shown on the right. Pressure lubrication is provided. The Brush alternator generates three-phase current at 400/440 volts and 50 cycles, on the four-wire system, and has an output of 55 kW, 0·8 power factor, at 1,000 r.p.m. Current at 230/250 volts single-phase can also be obtained. The machine is of the salient-pole revolving-field pattern, with drip-proof screen-protected enclosure, and is provided with two end-shield grease-lubricated ball bearings. The exciter is mounted on the top of the alternator frame and is driven by V-ropes from the alternator shaft. The engine and alternator are connected by a flexible coupling. The Brush switchgear panel comprises a triple-pole and neutral totally-enclosed fuse switch and three high rupturing capacity fuses; three current transformers; a terminal box; an ammeter with selector switch; a voltmeter and two voltmeter fuses, an automatic voltage regulator with hand automatic changeover switch; and a field regulator. The whole set is mounted on a steel channel base and is entirely self-contained, the only external connections being the outgoing cables and the exhaust pipe from the engine silencer.

The photograph reproduced in Fig. 53 shows a new method of finishing the bores of cylinder liners,

THE ENGINEERING AND MARINE EXHIBITION.

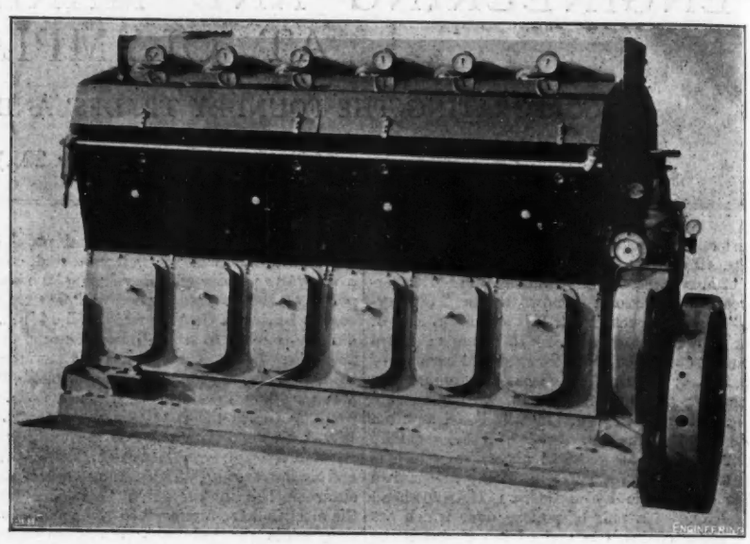


FIG. 51. TWELVE-CYLINDER V-TYPE DIESEL ENGINE; MESSRS. MIRLEES, BICKERTON AND DAY, LIMITED.

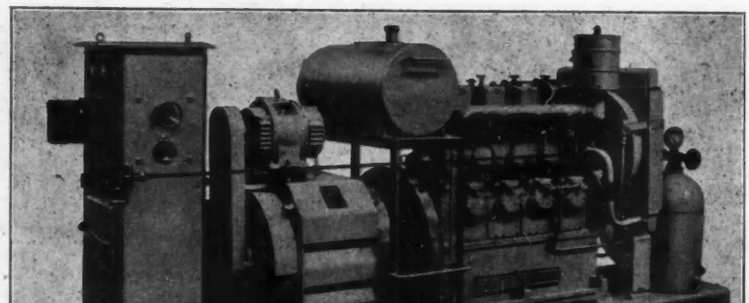


FIG. 52. 55-KW DIESEL-ELECTRIC GENERATING SET; MESSRS. ASSOCIATED BRITISH OIL ENGINES, LIMITED.

FIG. 53. "HONEYCHROME" CYLINDER LINER; MESSRS. PETTERS, LIMITED.

EXHIBITS AT THE ENGINEERING AND MARINE EXHIBITION.

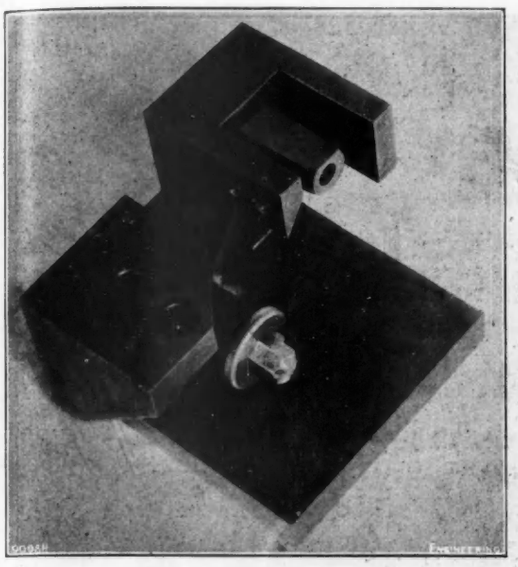


FIG. 54.

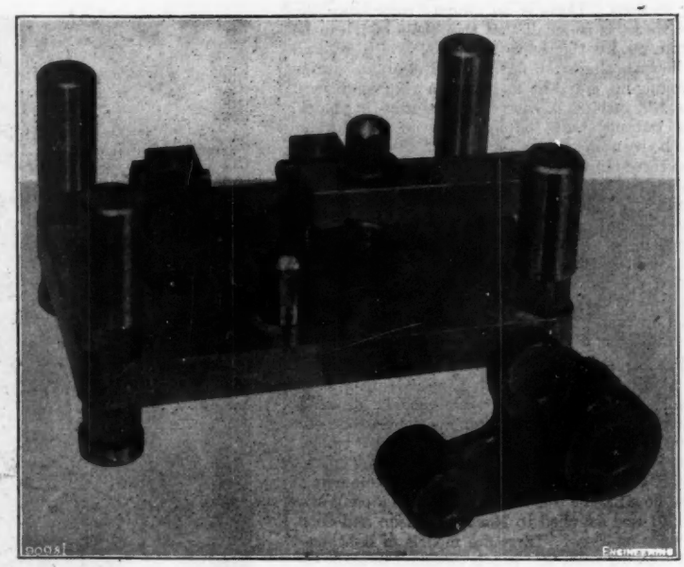


FIG. 55.

FIGS. 54 AND 55. JIG ASSEMBLIES MADE-UP FROM STANDARD PARTS; MESSRS. J. B. PUREFOY UNIT TOOLING, LIMITED.

which has been developed at the Loughborough works of Messrs. Petters, Limited, in collaboration with Messrs. Monochrome, Limited, Redditch, Worcester. Liners finished by this process, which is patented and registered under the trade name "Honeychrome," are now being fitted to all Petter superscavenge two-stroke Diesel engines. It should be explained that the finish is obtained by chromium plating the bore of the machined liner and that, after plating, the surface is not further treated by honing or grinding. As may be evident from the illustration, the surface is not continuous, but is covered with closely-pitched depressions, $\frac{1}{8}$ in. in diameter, giving it an appearance resembling that of perforated zinc. This appearance is only superficial, of course, the chromium plating, which is from 0·005 in. to 0·006 in. thick, being removed to a certain depth by an etching process to form the circular depressions. The finished surface is stated to have great hardness, up to 450 Brinell, the rate of wear being of the order of only 0·000125 in. per 1,000 hours. When the limit of wear is eventually reached, the liner can be replated and re-etched, so avoiding increase in piston diameter and thinning of the liner wall. The process requires a steel liner, since it is difficult to obtain good adhesion of the chromium plating to cast iron owing to the inclusion of graphitic carbon, silicon, etc., in that material. As it is, it is stated that perfect molecular adhesion is obtained between the steel and the chromium, so that flaking or peeling is entirely eliminated. The liner proper, apart from the finish, as used in the Petter superscavenge engines, has been developed by Messrs. Chesterfield Tube Company, Limited, Chesterfield, and is solid drawn from 0·40 per cent. carbon steel. The use of a solid-drawn heat-treated tube for the liner facilitates production, and homogeneity of the liner material is secured. It may be objected that, from the point of view of oil retention, chromium plating has markedly poor qualities, an objection which is entirely removed by the oil-retaining depressions; moreover, piston friction, which normally represents over 60 per cent. of the total engine friction, is substantially reduced and it is claimed that the mechanical efficiency is correspondingly increased.

The cost, in money and time, of making jigs and fixtures for small mass-produced parts may be considerable if each component of the jig has to be made from the start. The collection of standard elements which can readily be adapted and assembled for jigs, etc., shown on the stand of Messrs. J. B. Purefoy Unit Tooling, Limited, Upper Tilt Works, Cobham, Surrey, is, therefore, attractive from the practical point of view. Two examples of simple jigs assembled from some of the 400 or more standard elements available are illustrated in Figs. 54 and 55, above. In the first place, the body of the jigs can usually be constructed from a suitable portion cut from a length of sections of close-grained cast iron machined all over. The cross-section of these elements may be either of H, channel, angle, T, or unequal-armed T, form, the sections being available in different sizes ranging from $1\frac{1}{2}$ in. to 8 in. in length of side, and in overall lengths of either 18 in. or 24 in. The jig for a small lever having a short arm terminating in a palm and a long one ending in a boss, as can be seen in Fig. 54, shows how the elements are used. The corresponding casting would require a pattern and extensive machining. In the example shown in Fig. 54, a piece of the large angle section cut from the "bar" and with one leaf partly sawn away forms the base. To this is pinned, on the right, a short portion of a channel section, and, on the left, a portion of a smaller angle section, both also modified as required by sawing. Four bushes for the drilling of the lever palm can be seen on the top of this part, while two bushes for the boss drilling are visible on one side of the channel section. The mandrel for carrying the part, and the nut and horse-shoe washer are standard parts. A number of other standard parts go to the make-up of the simpler jig seen in Fig. 55. There is a plain base, feet and feet nuts, blocks with locating screws, a dowel and a cramp. The use of the jig will be obvious from the part seen in the foreground. With the aid of a list of available elements the jig designer should be able to select what is needed for a wide variety of jigs and fixtures so that they can be assembled with little additional work, and no special patterns are necessary; moreover, it is possible that, when a particular jig is no longer required, many of the parts could be utilised again, whereas a casting would probably have to be scrapped. The designer's work is facilitated by the provision of true-to-scale tracings which can be readily slipped into place under the tracing of the part for making the finished drawing of the jig. It should be understood that the types of elements available are much more extensive than above indicated. Several different types of finish are employed; for example, hardening and dull nickel plate, or hardening and grinding all over with gun black surface for the packing blocks.

The Parsons Marine Steam Turbine Company, Limited, Turbinia Works, Wallsend-on-Tyne, have an interesting exhibit, of which the main display consists of the two turbines illustrated in Figs. 56 and 57, on page 244. These form two of the elements of a three-turbine double-reduction set of machinery for a French vessel. The high-pressure turbine is not shown, that illustrated in Fig. 56 being the intermediate-pressure turbine with the high-pressure astern turbine on the left. The low-pressure turbine is shown in Fig. 57, the rotor on the left having ahead blading and that on the right astern blading. The double-reduction gear was not exhibited, but it may be noted that a total of 3,500 shaft horse-power is delivered through it, giving a propeller speed of 92 r.p.m. for ahead running. The astern power is 60 per cent. of the ahead power. The total ahead power is distributed as follows: high-pressure turbine, 1,220 shaft horse-power at 4,930 r.p.m.; intermediate-pressure turbine, 1,150 shaft horse power at 4,930 r.p.m.; and the low-pressure turbine, 1,130 shaft horse-power at 4,110 r.p.m. The pressure at the inlet of the H.P.-turbine is 415 lb. per square inch and the temperature is 740 deg. F., the corresponding figures for the I.P.-turbine being 83 lb. per square inch and 485 deg. F., while the temperature for the L.P.-turbine is 206 deg. F.; the condenser vacuum is 28·5 in. With regard to the arrangement of the turbines in the engine room, the high-pressure astern rotor in the intermediate-pressure turbine is located adjacent to the steam end of the high-pressure ahead turbine. The blading of this astern rotor, on the left of Fig. 56, is of the impulse type and consists of a three-row velocity-compounded wheel. The impulse blades are of stainless steel machined from rolled strip and individually fitted. Between the H.P. astern rotor and the I.P. ahead rotor is a diaphragm gland of the "radial" fin type. This gland has a leak-off connection to the condenser situated at a point midway along its length, the connection normally carrying off to the condenser the small amount of steam that passes the fins from the operating turbine and preventing its entry into the idling turbine.

The intermediate-pressure turbine rotor is for ahead running only; it is of the all-reaction "end-tightened" type with stainless-iron blades and shrouds having mild-steel packing sections. The low-pressure turbine shown in Fig. 57 has a cast-iron casing for its ahead and exhaust sections while the astern section has a cast-steel casing since this is subjected to both a higher pressure and higher temperature than obtains in the ahead section. The transverse joint between the two casings is made by bolts which are permanently drawn up during manufacture. The ahead blading

of the L.P. turbine, to the left of Fig. 57, is of the segmental all-reaction "radial-clearance" type, with blades of stainless iron having mild-steel packing sections. There is no dummy rotor since the end thrust is so small that the whole of it can be taken up by the adjusting block which is used to increase the axial blade shroud clearance during warming-up, stand-by and manœuvring conditions. The I.P.-turbine, of course, has an adjusting block. The output shaft coupling for the L.P.-turbine can be seen on the extreme left of the illustration. The three rings of blading on the right, as already stated, are for astern running. They are generally similar to the H.P. astern blading in type and material but are of larger dimensions and are supplied by a greater number of nozzles. These two turbines illustrate very well the present-day design and manufacture of the firm, the display being supplemented by a number of examples of reaction and impulse blading and by several miscellaneous models.

The display of Messrs. C. A. Parsons and Company, Limited, Heaton Works, Newcastle-upon-Tyne, consists almost wholly of scale models, drawings and photographs. Of the former, there is one of a 50,000-kW turbo-alternator to run at 3,000 r.p.m.; this is complete with surface-condensing plant. An historical exhibit illustrates the first commercial axial-flow blower constructed at the Heaton Works in 1901 and supplied to Messrs. Cookson and Sons, Howdon-on-Tyne. There are models of lighthouse and rotating reflecting panels designed to show the application of paraboloidal reflectors, and a model of the six-component balance installed in the high-speed wind tunnel at the Royal Aircraft Establishment, Farnborough.

Reference was made on page 199, *ante*, in connection with the exhibit of Messrs. National Gas and Oil Engine Company, Limited, to an engine fitted with reverse-reduction gear manufactured by Messrs. Modern Wheel Drive, Limited. An account of this type of gear is given below and illustrated by Figs. 58 to 60, on the opposite page. Our description deals with the general principles of the gear and does not refer specifically to the gearbox fitted to the engine above referred to. Messrs. Modern Wheel Drive, Limited, whose technical offices are at Lindo Lodge, Chesham, Buckinghamshire, manufacture a number of forms of the gear, all of which are oil-operated. Thus, the example shown in Fig. 58 is a plain reversing gear for marine propulsion, and is designed to transmit 45 brake horsepower at 400 r.p.m. This type is suitable for installation in such vessels as the smaller tugs, trawlers, coastal and deep-sea cargo ships, etc. On larger vessels of the same classes the type fitted may be similar to that shown in Fig. 59, this being a reverse-reduction gearbox transmitting 2,000 brake horse-power at 400 r.p.m. on the engine shaft, the reduction ratio being 6 to 1. Referring to Fig. 58, it should be explained that the engine to which it is fitted runs in one direction only, and that the input and output shafts are coaxial, bevel-gear transmission being arranged between them. The operation of this gear in reversing the direction of rotation of the propeller shaft will be referred to later, but the illustration does not make it clear that either bevel wheel can be locked to its shaft at will, since the flanged casings behind them contain the oil-operated clutches which effect this locking, the clutches not being visible.

These clutches are of the S.L.M. type (Swiss Locomotive and Machine Works), and the principle employed in them is shown diagrammatically in Fig. 60. The rotating shaft is indicated at *a*; it is furnished with splines on which the pair of inner elements *b* slide, these elements rotating with the shaft. The elements *b* are formed with tapering concentric projections which engage with corresponding grooves in the outer elements *c*. The two outer elements are bolted together to form one part which may carry a bevel wheel on one face, as in Fig. 58, or may have spur gear teeth on its periphery, according to the type of transmission required. The point is that the outer element *c* can be coupled to the shaft or not by the action of the inner elements *b*. When the clutch is disengaged the inner element rotates idly in the outer one, which is then stationary. As shown in Fig. 60, the

THE ENGINEERING AND MARINE EXHIBITION.

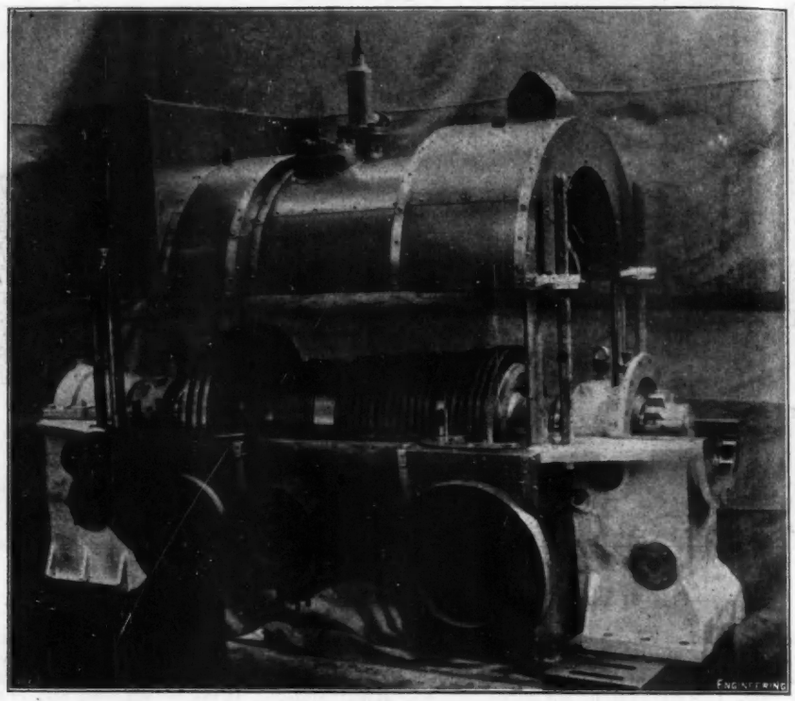


FIG. 56. H.P. ASTERN AND I.P. AHEAD TURBINE.

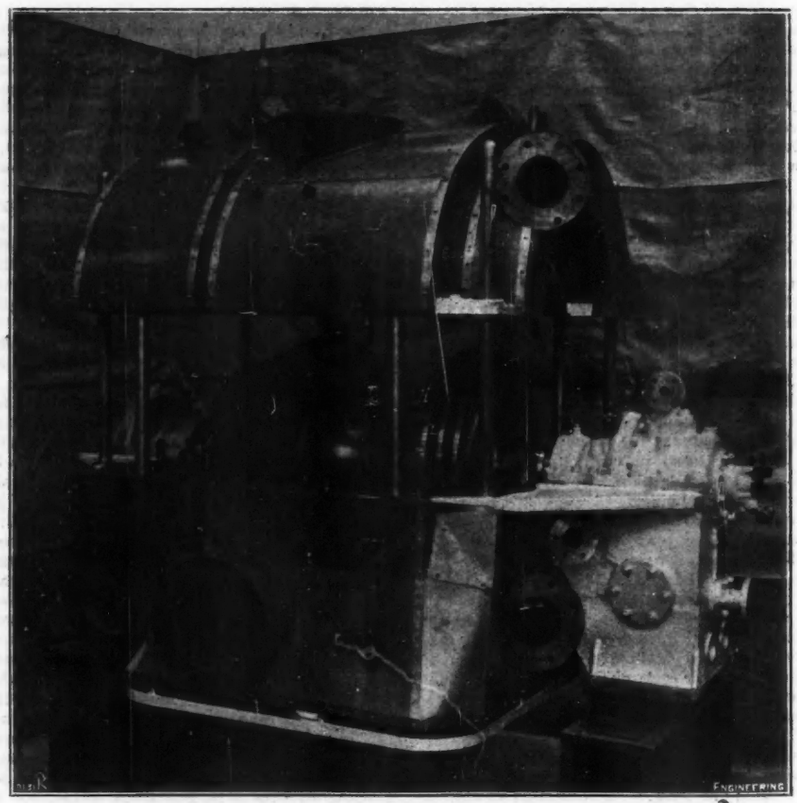


FIG. 57. L.P. AHEAD AND ASTERN TURBINE.

FIGS. 56 AND 57. MARINE STEAM TURBINES; MESSRS. PARSONS MARINE STEAM TURBINE COMPANY, LIMITED.

EXHIBITS AT THE ENGINEERING AND MARINE EXHIBITION.

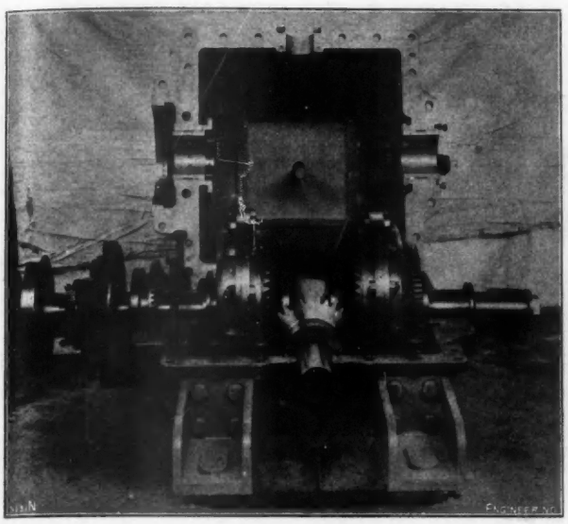


FIG. 58. OIL-OPERATED REVERSING GEARBOX.

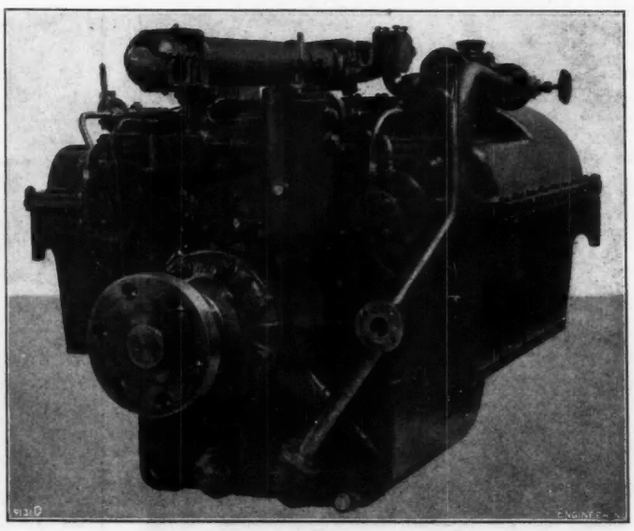


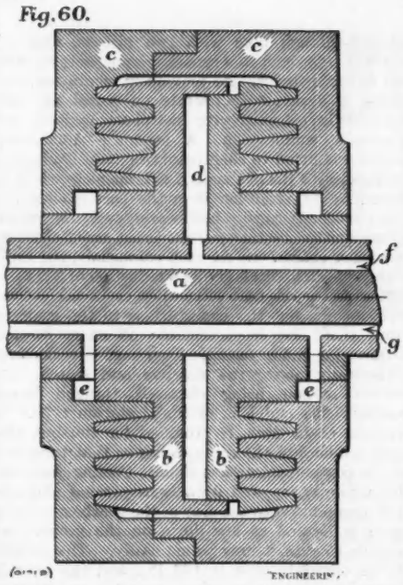
FIG. 59. OIL-OPERATED REVERSE-REDUCTION GEARBOX.

outer element rotates with the shaft, since the projections and grooves are maintained in close contact by oil pressure in the chamber *d*, and the resulting friction drives the outer element. To disengage the outer element, pressure is released from chamber *d* and applied in chambers *e*, when the inner elements move towards one another and contact between their projections and the grooves of the outer element is broken; the inner elements, therefore, continue to rotate while the outer one remains stationary. The pressure oil is introduced to the chambers *d* and *e* as required, through the passages *f* and *g*, respectively, these passages having radial ports as shown. The oil flow is directed into the various passages by a control cock.

In the above description of the construction of the S.L.M. clutch, the shaft *a* has been referred to as the driving shaft and the outer element as the driven part. This convention was adopted to simplify the explanation, but it will be obvious that the clutch will work equally well if the two functions are changed over, as, indeed, they often are in, say, reverse-reduction gearboxes. Considering such a gear as that shown in Fig. 58, the right-hand shaft may be regarded as being driven by the engine and having the outer element on the right keyed to it. The propeller shaft on the left passes into this clutch and carries on its extreme end the usual pair of inside elements. When the clutch is engaged, the drive to the propeller shaft is in the same direction as that of the engine. The bevel gears simply idle since the left-hand clutch is disengaged. To give the reverse direction to the propeller shaft, the right-hand clutch is disengaged and the left-hand clutch engaged. The right-hand outside element, with its attached bevel wheel, then drives the propeller shaft through the wheel train, the interposed pinions, of course, making the direction of rotation of the left-hand outer element, the reverse of that of the right-hand one. When reverse-reduction gear is required, the peripheries of the outer elements of the various clutches are formed with teeth and the wheels function as spur-wheels meshing with pinions on the engine driving shaft. This effects the desired speed reduction; the reverse gears are also of the spur-wheel type.

The gearbox shown in Fig. 59 is for reversing and reduction; an example similar to it being exhibited. The driving shaft is the flanged shaft seen towards the left; the two covers above it, with their centres in line with the gearbox joint, indicate the position of the reverse and reduction shafts. These are connected to the single propeller shaft which, as it leaves the gearbox on the other side, is not visible in the illustration. The connections seen on the two circular covers are part of the oil-supply system to the clutches. The supply-control cock can be distinguished at the top left by its vertical lever, different positions of which give ahead and astern movements, with a neutral position in which the engine idles. The pressure-oil system consists of a rotary pump, a by-pass valve and the control cock, with the necessary oil passages in the shafts, and external connecting pipes. The pump is seen on top of the gearbox in the upper right-hand corner of Fig. 59, the horizontal cylinder seen to the left being a tubular water-cooled oil cooler, and the vertical cylinder being an oil filter. It is understood that each of the mechanisms for ahead and astern motions embodies an S.L.M. clutch; if desired, the control cock can be arranged for operation from the deck. There are other examples on this stand; for instance, a twin-engine gearbox as used in the Admiralty Pacific tank-landing craft, two engines being coupled in the gearbox to drive a single propeller shaft. From this example it will be obvious that the design of the Modern Wheel Drive gearbox is very flexible; there are layouts, for instance, of a reverse-reduction gearbox which transmits the power of four engines, two on each side of it, to a single propeller shaft, the multiple-engine drive having distinct advantages where large powers are required and in certain other circumstances. It will be evident, moreover, that, as in the gearboxes for Diesel-engined locomotives, a speed-changing mechanism can be readily arranged, each of the pairs of change-speed wheels embodying an S.L.M. coupling. This means that there are no sliding gears, and that the various wheels and pinions are always in constant mesh; the latter condition applies also to the reverse-reduction gearbox illustrated.

Fig. 60.



FIGS. 58 TO 60. MARINE REVERSE GEARS; MESSRS. MODERN WHEEL DRIVE, LIMITED.

An engine that is new, so far as its marine application is concerned, is being shown on the stand of Messrs. Thomson and Taylor (Brooklands), Limited, Cobham, Surrey. The engine is manufactured by Messrs. Leyland Motors, Limited, Leyland, Lancashire, and has been developed for marine purposes in conjunction with Messrs. Thomson and Taylor, who are handling sales in this country. It is based on the well-known Leyland 7·4-litre engine, as used in their commercial vehicles, and its marine form has been designated the Leyland T and T marine power unit model M2. It is a six-cylinder engine having a continuous rating of 85 brake horse-power at 1,650 r.p.m. The cylinder block is cast separately from the crankcase and is fitted with dry cast-iron liners while the cylinder heads are in two identical parts, each of which covers three bores. Both the inlet and exhaust valves are located in the cylinder heads and these are operated through the usual arrangement of push rods and rocking levers. The camshaft is situated towards the top of the cylinder block and is driven by a Triplex roller chain from the front end of the crankshaft. The crankshaft is carried in seven main bearings of the pre-finished copper-lead steel-backed type, the bottom-end bearings being of a similar pattern but faced with lead-bronze. Aluminium-alloy pistons are fitted and these work in conjunction with H-section forged-steel connecting rods, the gudgeon pins being of the fully-floating pattern and retained in position by Circlips. A standard C.A.V. injection pump is fitted and this incorporates a mechanical governor for controlling the maximum speed and a vacuum governor which operates at intermediate throttle openings in such a manner that the engine speed remains constant at all loads. In addition, a flywheel is fitted to the injection pump in order to damp out any oscillations.

With the exception of the top ends, all engine bearings are supplied with oil under pressure from

EXHIBITS AT THE ENGINEERING AND MARINE EXHIBITION.

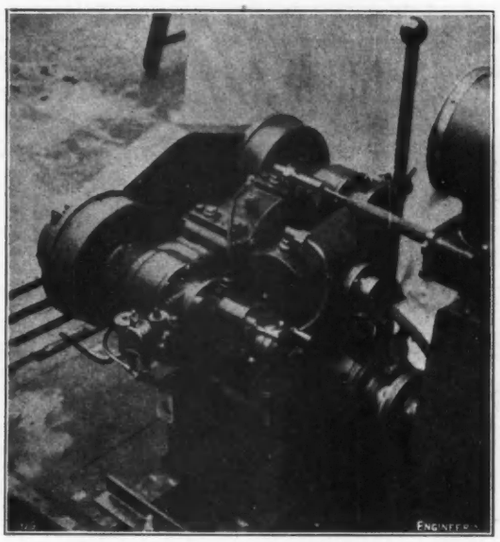


FIG. 61. "DOLPHIN" MARINE ENGINE; MESSRS. C. H. JOHNSON (MACHINERY), LIMITED.

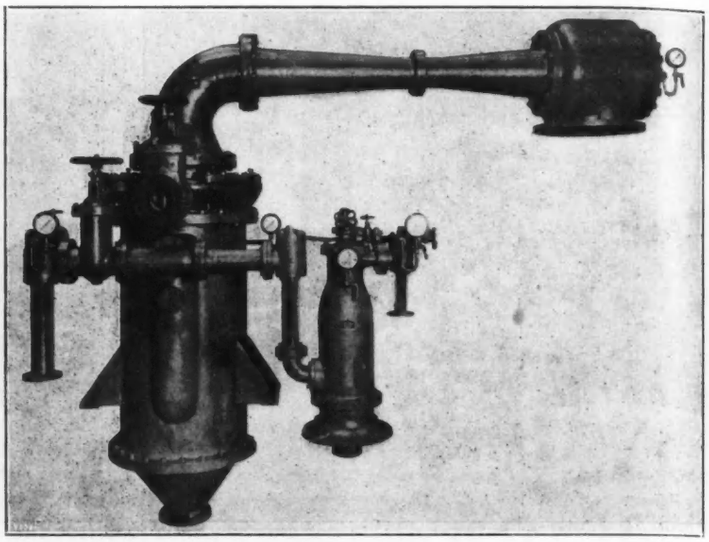


FIG. 62. STEAM-JET VACUUM PLANT; MESSRS. HICK, HARGREAVES AND COMPANY, LIMITED.

a gear-type pump, the crankshaft being drilled for bottom-end lubrication. The engine is available either with sea-water or closed-circuit fresh-water cooling, but in both cases the entire circulating water is passed through the water-jacketed exhaust manifold, the gearbox end cover, and the oil cooler. Sea water is circulated by a gear-type pump which is self priming and, when a fresh-water cooling system is fitted, the water is circulated by a centrifugal pump through a Serck heat exchanger. The temperature of the coolant is thermostatically controlled, a notable point being that the thermostat can be adjusted to suit the different operating conditions encountered in various parts of the world.

The gearbox forms a unit construction with the engine and, in both the ahead and astern positions, gives a reduction ratio of 2 to 1. The ahead and astern gears are selected by two dry-plate clutches, a separate clutch being provided for each gear train. The astern clutch plate is integral with a shaft which extends towards the rear of the box, and keyed to this shaft is a pinion which drives one of a pair of gear wheels keyed to the end of the propeller through an idler wheel. The ahead clutch plate, however, is integral with a sleeve which shrouds the astern shaft and the end of the sleeve remote from the clutch is fitted with a pinion which meshes directly with the other gear wheel of the pair fitted to the propeller shaft and referred to previously. The gears are lubricated by a self-contained system within the gearbox, while the selector gear is lubricated by grease. The clutches are selected by over-centre toggles, the toggles being spring loaded so as to compensate for wear of the clutch linings. A 24-volt electric starter motor is fitted and, in addition, a hand starting crank, together with a foot-operated de-compressor, is provided for emergency starting. The hand-starter shaft runs the full length of the engine, thereby giving forward or aft starting positions, and, in consequence, the engine can be installed either with the forward end against a bulkhead or with the gearbox under the deck. When the unit is required for operation under arctic conditions, ether starting equipment can be installed.

A new design of two-stroke petrol engine is being shown by Messrs. C. H. Johnson (Machinery), Limited, Adswood-road, Stockport. The engine, which is known as the Dolphin, is illustrated in Fig. 61, above, where it is shown on the test bed. It is intended for use on light launches, etc., and has a continuous rating of 5 brake horse-power at 2,400 r.p.m. It is of the opposed-piston type, there being a single cast-iron cylinder having a straight-through bore with two pistons, each of which is connected to a separate crankshaft at each end of the cylinder. As previously mentioned, the engine is designed to operate on petrol and the cylinder is charged with petrol-air mixture by crankcase compression. A separate Amal carburettor is fitted to each crankcase, and ignition is provided by a B.T.-H. type K.C.I. magneto which is driven by an extension from the port crankshaft. The crankshaft runs in ball bearings and the power is transmitted to the gearbox input shaft through two roller chains, one for each crankshaft, the ratio of the sprocket wheels giving a reduction of 2·7 to 1. Piston and crankshaft lubrication is on the petrol-oil principle, but the chain drives to the gearbox input shaft run in a separate oil sump formed within the chain casing. The engine is located horizontally above the gearbox and clutch, the reverse motion being obtained through bevel gearing; the clutch is of the Anderton type. A separate chain drive is provided for starting, the chain running in the same casing as that provided for the power-transmission chains. Cooling water for the engine is supplied by a cam-operated plunger-type pump fitted to the side of the gearbox and the pump is located as low down on the gearbox as possible so that it may prime easily. The weight of the complete unit is 186 lb., and the overall dimensions are: width 2 ft., length 2 ft. and height, excluding the gear lever, 1 ft. 5 in.

The firm of Messrs. Hick, Hargreaves and Company, Limited, Soho Ironworks, Bolton, are showing examples of their single-stage and two-stage rotary compressors and vacuum pumps, and of such steam-plant auxiliaries as evaporators, condensers and a variety of other apparatus, including a back-pressure steam turbine with an output of 500 kW. The early history of the firm is appropriately commemorated by a model of a beam engine built in 1840, when the company had been in existence for seven years. The vacuum plant, illustrated in Fig. 62, above, is a typical example of a much more modern product. This plant is designed for the treatment of edible oils, both of fish and vegetable origin. It consists of a barometric jet condenser with a vacuum augmentor, and has, as shown on the left of the illustration, a single-stage quick-starting ejector for the rapid evacuation of the system at the beginning of the batch process, after which the vacuum is maintained by the two-stage ejector seen on the right. The barometric jet condenser requires 8,000 gallons of water per hour at a temperature of 30 deg. C., and the steam consumption of the plant is 800 lb. per hour at a gauge pressure of 200 lb. per square inch. The degree of vacuum produced varies according to whether the single-stage or two-stage ejector is in use. It may be noted, however, that single-stage ejectors are suitable for creating vacua up to 26 in. Hg, and two-stage ejectors up to 29 in. Hg. When three-stage ejectors are employed, absolute pressures down to 3 mm. Hg can be obtained, while a four-stage equipment will produce absolute pressures down to 1 mm. Hg, or lower. Pressures of the order of 1 mm. Hg absolute are required in certain chemical processes, such as the distillation of essential oils, synthetic resins, etc., and a four-stage plant to obtain them would have a steam consumption of 200 lb. per hour at a gauge pressure of 150 lb. per square inch, and a water consumption of 300 gallons per hour. The standard materials of construction are cast iron for all low-pressure parts, with forged-steel steam heads for the high-pressure steam and stainless steel for the steam nozzles. In cases where chemical action may set up severe corrosion, acid-resisting bronze may be used, or an acid-resisting lining may be attached to the parts likely to be affected.

The stand of Messrs. Megator Pumps and Compressors, Limited, Feltham, Middlesex, is devoted wholly to different examples of the interesting pump illustrated in Figs. 63 to 66, opposite. It is difficult to classify this pump, since the necessary variation in volume for the suction and return strokes is effected by a rotating member while the operations of opening and closing the ports are effected by a sliding member; the latter are, therefore, of a positive nature. The combination of rotating and sliding members, however, results in a very simple pump and one that is easy to dismantle and clean; certain other advantages will be referred to later. The external appearance of the pump is well shown in Fig. 63, in which it is coupled directly to an electric motor. The pump body is an almost cubical casing with the suction and delivery branches on one side at the top, the opposite side being occupied by a cover which, when removed, exposes the whole of the internal working parts. The sides of the casing carry brackets for the ball bearings of the rotating shaft. The form of the casing lends itself very well to other arrangements of drive, one of the examples exhibited showing the driving motor mounted on top of the pump, the drive being through multiple V-belts; this arrangement makes a very compact unit which is useful in cases where space is limited.

The sectional illustrations, Figs. 64 and 65, show the construction and operation of the pump.

EXHIBITS AT THE ENGINEERING AND MARINE EXHIBITION.

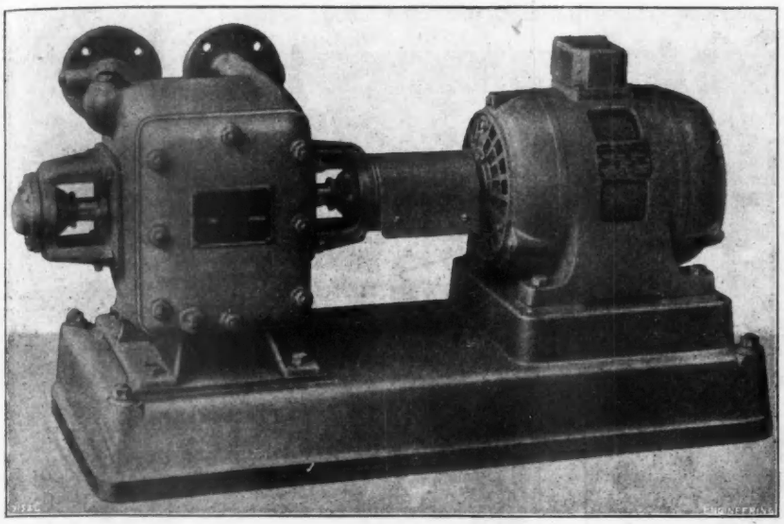
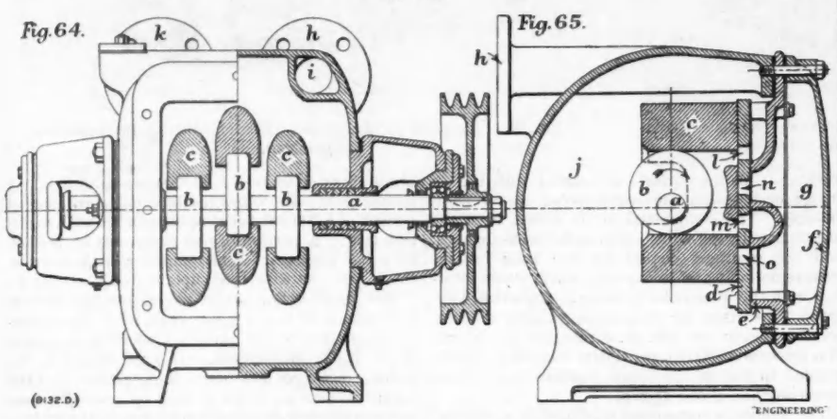


FIG. 63.

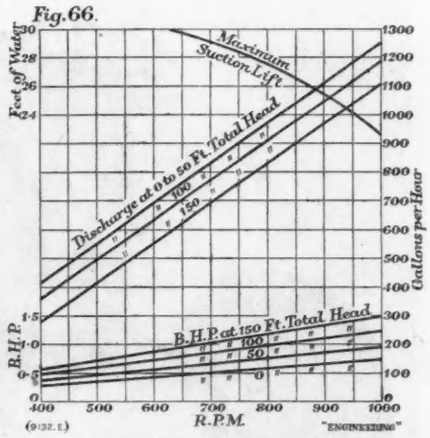


FIGS. 63 TO 66. MARINE PUMP; MESSRS. MEGATOR PUMPS AND COMPRESSORS, LIMITED.

The rotating shaft, indicated at *a*, carries three eccentrics *b*, which may be either integral with the shaft or keyed to it. The eccentrics are set on the shaft at 120 deg., so that the displacement resulting from all three rotating together at the same speed but in different phase gives a smooth continuous flow and an even turning moment. The eccentrics rotate in individual valves or shoes *c*, the outer end of which is roughly horseshoe-shaped while the inner face slides on the ported liner *d*, and, to a certain extent, resembles an ordinary slide valve. These shoes are of composite construction, employing phenolic plastic and natural or synthethic rubber, and are virtually incorrodible. Since they work in contact with a metal eccentric and a metal liner, they give satisfactory resistance to abrasive wear. It will be evident from Fig. 65, that, as each eccentric rotates, two events occur, firstly the volume inside the shoe increases for the suction stroke and decreases for the delivery stroke and secondly the shoe reciprocates vertically, the openings in its face covering and uncovering the suction and delivery ports in the liner *d*. This liner is attached to the inside wall *e* of the cover *f*, the wall being formed with ports matching those in the liner *d*. The chamber *g* of the cover forms the suction side of the pump and communicates with the suction branch *h*, through the passage *i*, Fig. 64. The chamber *j*, in which the shoes and eccentrics work, is the delivery chamber and the delivery branch *k* opens directly from it. The face of the shoe is thus held in close contact with the liner as long as there is any pressure in the chamber *j*.

One of the eccentrics is shown in Fig. 65 making its delivery stroke, and the liquid contained inside the shoe is being expelled through the ports *l* and *m*, which both communicate with the chamber *j*. The delivery stroke ceases when the eccentric reaches its inner dead centre, the eccentric periphery, in that position, being in contact with the curved inner portion of the shoe and all the ports being closed. Further movement in a clockwise direction from the inner dead centre increases the volume inside the shoe and, at the same time, the shoe moves downwards and uncovers ports *n* and *o*. The liquid in chamber *g* then passes into the shoe until the eccentric reaches the outer dead-centre position, in which the maximum volume is obtained inside the chamber and all the ports are again closed. This half-revolution, from inner dead centre to outer dead centre, constitutes the suction stroke and the other half-revolution, shown in course of being made in Fig. 65, constitutes the delivery stroke. It will be seen from Fig. 65 that the two-part cover and its attached liner can be removed as a whole, when the shoes can be withdrawn and examined, or renewed if necessary. Any wear on the face of the resilient shoes is automatically taken up owing to the constant action of the delivery pressure. The shaft *a* is made watertight in the casing by glands of the usual type and is supported by the external ball bearings shown in Fig. 64; lubrication is thus reduced to the occasional replenishment of the grease in these bearings. The pump is made in several sizes and its performance is shown by the graph Fig. 66, which will be self-explanatory.

Fig.66.



The curves relate to the M16 size, which has suction and delivery branches 1¼ in. in diameter, and under normal conditions an output capacity of 17 gallons per minute, the maximum suction lift being 25 ft. The total head is 150 ft., and the pump runs at 960 r.p.m. and requires a 2-h.p. motor.

Messrs. Evershed and Vignoles, Limited, Acton Lane Works, Chiswick, London, W.4, are showing an example of their electronic repeater, which is designed for the distant indication of variable physical quantities. The chief advantages claimed for this system are that it operates on direct-current, using simple indicators; and the accuracy of repetition is independent of the line resistance and supply voltage. The varying physical quantity is arranged to exert a torque proportional to its value on an arm carrying a coil and contact. The coil works in a pot magnet and the moving contact, which is on the end of the arm, oscillates between two fixed contacts. The coil is in the anode circuit of a triode valve, this circuit being completed through the distant indicators and recorders, which are electrically connected in series. The contact carried by the arm is connected to the grid of the valve, while the two outside contacts carry positive and negative biasing voltages, respectively, so that the anode current of the valve can be altered as required. The current through the coil is normally such as to provide an equal and opposite torque to that exerted by the quantity under measurement. If the quantity, and hence the torque, changes, however, the arm moves over and one of the biasing contacts is made. The anode current is thereby increased or decreased, as required, until the two torques are again balanced and the moving contact returns to the central position. A condenser and resistance are connected across the grid circuit of the valve to provide the required biasing voltage. The system thus supplies a direct current to the transmission lines which is proportional to the physical quantity being indicated. A range of transmitters for various duties is being exhibited. Some of these contain measuring instruments, while others are designed for direct coupling to the mechanism, the positions of which are to be repeated. Applications of the repeater are the remote indication of such quantities as water level and water, gas and steam pressures and flow. Electrical quantities and mechanical positions, such as the extent of opening of valves and sluice gates, can be shown, and the apparatus can be used for the selection and control of distant switchgear.

This firm are also exhibiting examples of their position controllers, the stand being constructed to give a practical demonstration of the latest designs of this equipment. These controllers consist essentially of hand-operated transmitters, which are connected electrically to one or more distant receivers, known as slave units. Any movement of the transmitter causes a proportional movement of the slave units, which develop sufficient power to operate such mechanism as engine throttle levers, aircraft trim tabs and faceplate controllers over a maximum

EXHIBITS AT THE ENGINEERING AND MARINE EXHIBITION.

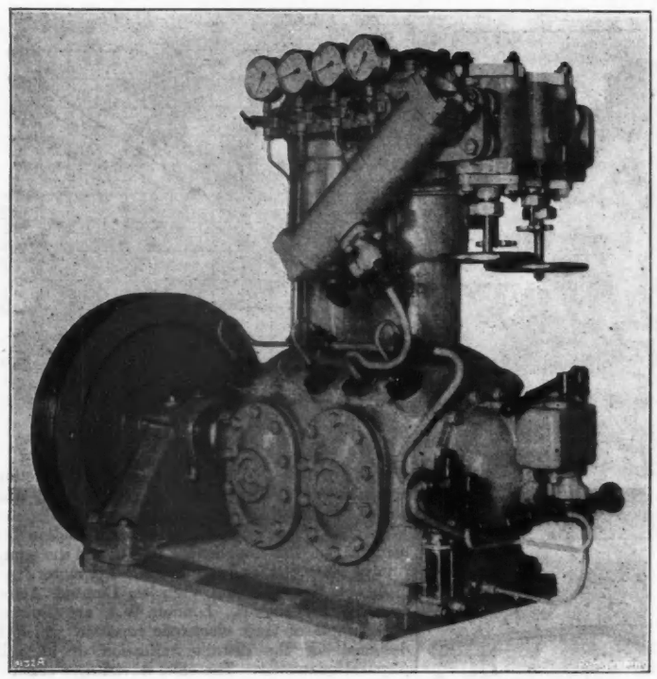


FIG. 67. TWO-CRANK TWO-STAGE AIR COMPRESSOR; MESSRS. PETER BROTHERHOOD, LIMITED.

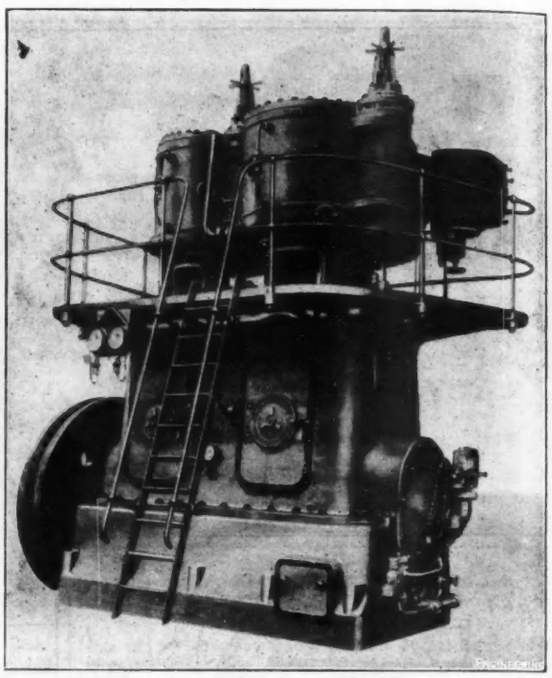


FIG. 68. AMMONIA COMPRESSOR; MESSRS. PETER BROTHERHOOD, LIMITED.

range of a quarter of a mile. Servo-mechanisms are represented by the firm's MU unit, in which the effort available at the load is 50 ft.-lb. at speeds up to 3 r.p.m., and the accuracy obtainable is within 1 part in 1,500. It is claimed that with additional components an accuracy to within one part in 50,000 can be achieved.

From the varied collection on the stand of Messrs. Peter Brotherhood, Limited, Peterborough, we select for illustration an air compressor and an ammonia refrigerating compressor, illustrated, respectively, in Figs. 67 and 68. The air compressor shown is of the firm's vertical two-crank two-stage double-acting machine with forced lubrication and has a capacity of 1,083 cub. ft. of free air per minute to 135 lb. per square inch pressure when running at 365 r.p.m., this capacity being based on the nozzle test recommended by the British Compressed Air Society. The particular machine exhibited will form a unit in a chemical plant which will be run without a stop for months together, and the design therefore provides for continuous operation. Each of the two stages of compression is effected in a separate double-acting water-cooled cylinder, an arrangement which is claimed to be more suitable than the differential-piston and single-acting trunk types of machine. The pressure difference across the piston rings is considerably less and the liability to loss of compressed air by leakage is correspondingly reduced. There is a more even turning moment, since the cranks are set at an angle of 90 deg. and are fitted with large balance weights for static balance. The machine runs smoothly and it is stated that there is an almost complete absence of vibration and shock to the driving unit. All cylinders and pistons are accessible without the necessity for dismantling superimposed parts, other than the cylinder covers. Each cylinder has its own separate oil supply from an adjustable mechanical lubricator. The connecting-rod side thrust is taken on guides having forced lubrication and not on the cylinder walls. The air is compressed in both the cylinders on both the up and down strokes; in consequence, the reversal of loading during each revolution improves the lubrication of the crankshaft bearings resulting in improved mechanical efficiency and less wear. The duplicate oil strainers enable cleaning of either to be done while the machine is running. All the surfaces in contact with the air under compression are water-cooled as far as is possible. The compressed air is sealed from the atmosphere by self-adjusting metallic-packed glands, and the resultant virtual freedom from leakage ensures no falling off in capacity which would interfere with the intercooler pressure. A vertical two-crank three-stage air compressor capable of compressing nearly 200 cub. ft. of free air per minute to a pressure of 600 lb. per square inch, and directly coupled to one of the firm's vertical single-crank steam engines, is also shown.

The ammonia compressor exhibited is a vertical two-crank two-stage machine of the crosshead type and has forced lubrication. It has a capacity of 150 tons refrigeration. The actual machine shown is one of four being supplied to a new oil refinery in the Middle East. The machine is driven through V-ropes, but the large grooved driving pulley has not been fitted. The compressor is of the annulus type; that is, the piston and cylinder have two diameters, there being an annular space in the cylinder between the larger top portion and the smaller bottom portion. This arrangement ensures that no compression takes place in the buffer space surrounding the piston rod and adjacent to the piston-rod gland, this space, being connected by a large pipe to the suction side of the machine, is thus maintained at the low suction pressure and temperature. The piston rod and gland are not therefore subject to varying temperature and pressure and there is stated to be no leakage from the gland. There is no refrigerant in the crankcase and there are no idle strokes.

Of the other machines on Messrs. Peter Brotherhood's stand attention may be drawn to the firm's metering and proportioning pump, of which an illustrated description was given in ENGINEERING, vol. 162, page 417 (1946). The actual pump exhibited is designed to deliver a maximum of 160 gallons per hour at a pressure of 400 lb. per square inch, but the type is also made to deliver at pressures up to 6,000 lb. per square inch and for deliveries up to 200 gallons per hour. There are two examples of steam turbines to be seen, one being a single-stage impulse turbine designed to develop 100 brake horse-power at 4,000 r.p.m. with steam at a pressure of 110 lb. per square inch, and when exhausting to atmosphere or against a back pressure of 3 lb. per square inch. The other machine is the mechanical portion of a 200-kW turbo-alternator set with reduction gear. A portion of the steam can be bled off for other purposes. When supplied with steam at 180 lb. per square inch and superheated by 50 deg. F., 11,000 lb. of steam can be passed out per hour at a pressure of 15 lb. per square inch, while the remaining steam goes to the condenser where a vacuum of 26 in. Hg is maintained. In this condition, the turbine develops 300 brake horse-power at 4,000 r.p.m. When no steam is bled off and all passes to the condenser at the vacuum stated, the turbine develops 225 brake horse-power. There are several other machines of different types in the display, as well as a scale model of the Brotherhood chimney-type natural-draught timber water-cooling tower.

(To be continued.)

INSTITUTE OF FUEL.—The Melchett Medal of the Institute of Fuel, for 1947, has been awarded to Major Kenneth Gordon, O.B.E., M.C., M.A., who will deliver the Melchett Lecture on "Hydrogenation in the Fuel and Chemical Industries" at 2.30 p.m., on Thursday, October 16, at Gas Industry House, 1, Grosvenor-place, London, S.W.1. The President of the Institute, Dr. C. H. Lander, C.B.E., will take the chair and present the Medal.

CONFERENCE ON CO-OPERATION THROUGH EDUCATION.—The British Association for Commercial and Industrial Education, 107, Baker-street, London, W.1, has organised a week-end conference, on "Co-operation Through Education," to be held at Ashridge, Berkhamsted, Hertfordshire, from October 3 to 6. Briefly, the conference will deal with the realisation of improved production and increased happiness at work by means of employee education and training schemes. The speakers will include Sir Charles Tennyson, C.M.G., President of the Association, Sir George Schuster, K.C.S.I., K.C.M.G., Mr. Harold Clay, and Lieut.-General Sir Ronald Weeks, K.C.B., D.S.O. We are informed that employers, industrial education and training officers, and representatives of schools or local-education authorities concerned with the further education of young employees, will be welcomed at the conference, which will be a residential one, the inclusive fee being three guineas. A detailed programme of the conference and further particulars may be obtained from the secretary of the Association, at the above address.

TESTS OF BOGIE-CONTROL DEVICE.

SWISS LOCOMOTIVE AND MACHINE WORKS, WINTERTHUR, SWITZERLAND.

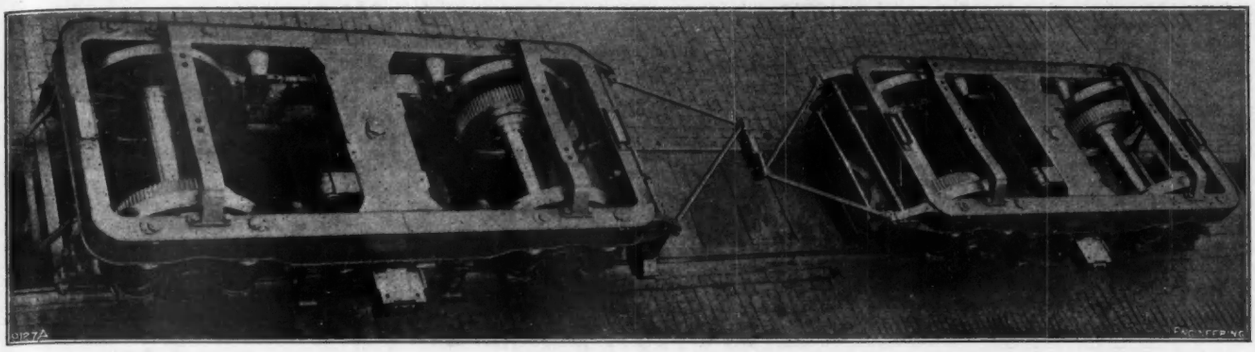


FIG. 1. COUPLING APPLIED TO TWO BOGIES.

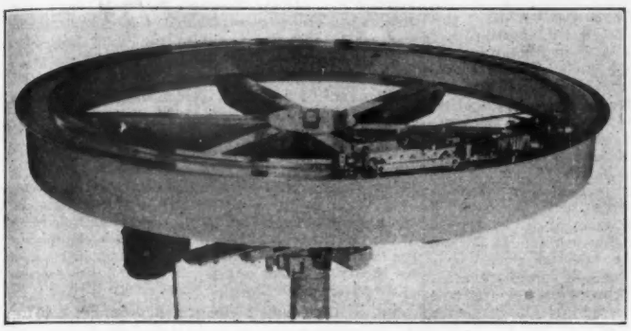


FIG. 2. MODEL-BOGIE TESTING APPARATUS.

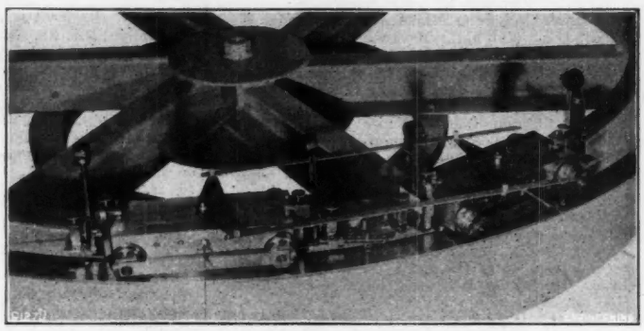


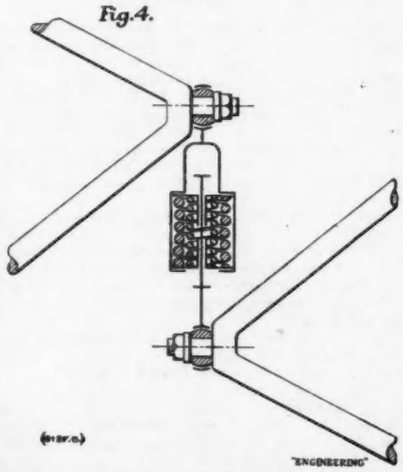
FIG. 3. MODEL BOGIES ARRANGED FOR TEST.

TESTS OF BOGIE-CONTROL DEVICE.

IN Switzerland, where not only carriages and wagons, but also electric and Diesel-electric locomotives are commonly constructed with a pair of bogies, and where curves in the track are numerous, the control of bogies to promote smooth running and reduce flange wear is of particular importance; and the Swiss Locomotive and Machine Works, Winterthur, have devised a simple coupling to effect this, as well as apparatus for demonstrating the principles involved. A pair of four-wheeled, or six-wheeled, bogies are joined by a spring coupling at the ends of two yokes on the bogies, as illustrated in Fig. 1; a diagrammatic section through the spring coupling is shown in Fig. 4. A general view of the experimental apparatus is given in Fig. 2, and a closer view of the model bogies and associated apparatus in Fig. 3.

As shown in Fig. 2, the apparatus consists of a horizontal wheel, which may be rotated by hand or by means of an electric motor, and the upper edge of the wheel represents the track. It is, therefore, the circular track which moves, the bogies being held stationary by a cord connecting the front of the leading bogie with any convenient fixture. The "track" consists of two parallel flat paths, with a wide shallow groove between them. There is no superelevation, as the stationary bogies are not affected by centrifugal force, unless this is artificially simulated by a pull on a cord attached to the side of the bogie, as shown in Fig. 3. Each bogie consists of a rectangular steel block with four wheels or rollers without flanges, and the bogie is constrained to remain on the track by two guiding wheels, one at each end, on the underside of the block with their axes vertical. These guiding wheels run in the shallow groove of the track, and are smaller in diameter than the width of the groove, to allow some lateral movement of the bogies. They thus resist the lateral forces which are normally absorbed by the wheel flanges, and such forces are readily measured by means of four Huggenberger tensometers, which are fitted one at each end of each bogie, as shown in Fig. 3. The bogie pivots are connected by a light frame which represents the underframe of the vehicle; and the coupling to control the motion of the bogies is, in this case, a simple arrangement of links without any springs. The behaviour of a bogie, and a pair of bogies, on a curved track may now be described, by

Fig.4.



referring to the experimental apparatus, which adequately demonstrates the phenomena.

Considering a single independent bogie: as soon as it is propelled on a curved track (or, as in the apparatus, the track is propelled in relation to it), it assumes a position in which the rear axle tends to be radial to the curve, and the front outside and rear inside wheel flanges exert forces on the outside and inside rails, respectively. In the model, these forces are resisted by the guiding wheels and measured by the tensometers; and, as the model shows, the forces will act without any centrifugal force. It may be shown that the forces increase with the load on the axles, but the speed has no appreciable effect. If, now, an increasing lateral force—a centrifugal force, for example—acts at the centre of the bogie radially outwards, the rear axle will gradually shift over towards the outside rail, and eventually, when the lateral force has reached a certain value, it will cause a flange force to be imparted to the outside rail by the rear outside wheel (or by the guiding wheel, in the case of the model). The value of the lateral force, which is required to cause the rear outside wheel flange to make contact with the rail, may be calculated, and depends on certain characteristics of the bogie and track. Simultaneously, the increasing lateral force adds to the flange force of the front outside wheel, but not to the extent that would be expected by considering the moment of the lateral force on each axle; and the movement of the rear axle to the outside reduces the angle of incidence or "attack" of the front outside wheel flange on the curved rail. The rate of wear of the flange is a function of the angle of incidence and the flange force. The rate of wear of the front outside wheel flange, therefore, will tend to increase with the increase in the lateral force which is applied to the bogie, due to the increasing flange force; but in certain cases the rate of wear of the front outside wheel flanges may decrease due to the effect of the smaller angle of incidence. This behaviour of a bogie subjected to a lateral force while travelling on a curved track, shows that centrifugal force has not as much influence as is generally believed on flange forces and rate of wear.

Consider, again, the motion of a single bogie on a curved track. If a lateral force acting towards the outside of the curve is applied to the bogie (or a rear extension of the bogie) on its longitudinal centre line at a point to the rear of the rear axle, the flange force of the outside front wheel is reduced. As the lateral force is increased the rear wheels tend to move away from the inside rail towards the outside rail, and, when a certain value of the lateral force is reached, the flange of the rear outside wheel rides on the outside rail, similarly to that of the front outside wheel. A further increase of the lateral force reduces the flange force of the front outside wheel to zero, and the front axle is then in a state of unstable equilibrium. This is undesirable, because the front axle and wheels may oscillate laterally very violently between the rails.

Another experiment with a single bogie shows that the natural tendency of a bogie on a curved track to assume the out-of-line position which has been described already, may be corrected, and the bogie guided entirely, by a lateral force directed towards the inside of the curve and applied forward of the front axle on the longitudinal centre line of the bogie. These two methods of guiding a bogie on a curved track, namely, a lateral outwards force at the rear of the bogie, and a lateral inward force at the front of the bogie, are applied to the front and rear bogies, respectively, of a vehicle, by coupling them together as shown in Figs.

1 and 4, so that they mutually correct the tendency of each to assume the out-of-line position. The bogies are coupled by two triangular yokes, one on each bogie, connected together by a spring coupling (Fig. 4). The spring coupling allows an initial side-play, which may be adjusted to any value between 20 and 50 mm.; and further relative movement is controlled by two helical springs, which may be adjusted to allow a maximum movement of 24 mm. As Fig. 4 shows, relative movement of the yokes may be towards or away from each other, and such a provision is clearly desirable for the occasions when the vehicle is traversing a section of track in which the radius of curvature varies between the bogies. Relative angularity of the two bogies is allowed by the ball joints between the ends of the spring coupling and the two yokes.

At its best, this connecting device will ensure that the two bogies are guided almost wholly by the front pair of wheels of the leading bogie, and, in any case, it reduces the angles of incidence of the wheel flanges on the rail, reduces the flange forces, and consequently the wear of flanges and rails. In certain cases, however, it is possible for the bogies connected by this device to be unstable on a curved track; but this can be checked when designing the vehicle, and avoided by careful design and suitable adjustment of the spring coupling.

INSTITUTION ELECTIONS

INSTITUTION OF CIVIL ENGINEERS.

Associate Member to Member.—Arthur Fynes Brennand, B.A. (Cantab.), Maidstone; David Currie, Leeds, 1; John Douglas, Berkhamsted, Herts.; Bruce Sheen Dowling, M.C., B.E. (Sydney), Sydney, N.S.W., Australia; Eric Downes, M.C., B.Sc. (Eng.) (Lond.), Cambridge; Isaac Kursbatt, B.Sc. (Eng.) (Lond.), Oxford; Colston Wilfred James Mountford, B.Sc. (Eng.) (Lond.), Leeds, 1; Tuppiage Peter de Silva Munasinghe, Mahamodera, Galle, Ceylon; Eric Hubert Vick, London, W.7; Ernest Wall, M.C., Lagos, Nigeria.

INSTITUTION OF MECHANICAL ENGINEERS.

Member.—Herbert Ernest Gearing, Cape Town; Air Vice-Marshal Robert Owen Jones, C.B., A.F.C., B.A. (Cantab.), London, W.C.2; Comdr. (E) Kenneth Joseph Robb Langmaid, R.N., Bath; Lionel Lynes, Brighton; William Leonard Owen, M.Eng. (L'pool), Warrington.

Associate Member to Member.—George Frederick Barnes, Stoke-on-Trent; Col. Francis John Littlefield Coller, R.E.M.E., Aldershot; Hugh Ford, Ph.D., B.Sc. (Eng.) (Lond.), Wh.Sc., London; Harold Samuel Hull, London; Richard Faithfull Reddick, London; Ernest Roger Watkins, B.Sc. (Manch.), London; Harry West, Manchester.

INSTITUTE OF MARINE ENGINEERS.

Member.—Kenneth Coules Barnaby, Southampton; Philip Frederic Chesters, Lewisham; Thomas Clark, Wanstead; Hugh Coburn, Hounslow; George Culshaw, Liverpool; Norman John Hyacinth D'Arcy Woking; Arthur Brian Durston, Harlow; Vincent Elordieta, Montreal, Canada; William Frederick Fletcher, Montreal, Canada; Robert Henderson, Leigh-on-Sea; John Howard King, Edinburgh; John Laing, Glasgow; Alexander Lightbody, Aberdeen; Henry Thompson Lockey, Ilford; James Herbert McNeil, Prescot, Lancs.; Wolfgang May, London, N.W.3; Robert James Cordiner Mitchell, Paisley; William Monteith, Glasgow; John White Morgan, Glasgow; James Hamilton Nairn, Sheffield; John Sayer Nicholson, Swansea; John Arthur Nicolson, Huddersfield; William Haig Robertson, Liverpool; David Skae, Bebington; Joseph Frank Stratta, Bermondsey; Robert Graham Turnbull, Belfast; Lt.-Comdr. (E) Joseph William Wright, R.I.N., Wanstead.

Associate to Member.—Thomas William Burt, London, S.W.1; Gordon Edward Dunk, Hartlepool; Desmond Gerald Dymott, South Littleton, near Evesham, Worcs.; Donald Eric Miller, Liverpool; Dennis Webster, Upminster, Essex.

Associate Member.—Alexander William Duncan, B.Sc., Thornaby-on-Tees; Lieut. (E) Franciszek Preisner, P.N., Plymouth.

SHEET AND STRIP METAL USERS' TECHNICAL ASSOCIATION.—The annual general meeting and autumn conference of the Sheet and Strip Metal Users' Technical Association will be held at the Waldorf Hotel, Aldwych, London, W.C.2, on Thursday and Friday, September 25 and 26. At 2.30 p.m., on the first day, Mr. H. Brooker will present a paper on "Sheet-Metal Brazing," and on the second day, Friday, September 26, at 10 a.m., Mr. J. N. T. Adcock will deal with "The Application of Paint to Metal Surfaces"; at 2.30 p.m., Mr. E. A. Evans and Professor H. W. Swift will speak on "Deep Drawing with Special Reference to Lubrication." The honorary secretary is Mr. A. McLeod, 49, Wellington-street, London, W.C.2.

BRITISH STANDARD SPECIFICATIONS.

THE following specifications of engineering interest have been issued by the British Standards Institution. Copies are obtainable from the Publications Department of the Institution, 28, Victoria-street, London, S.W.1, at the price quoted at the end of each paragraph.

Microfilm, Readers and Reels.—As is well known, microfilm is used for reproducing records and files for the purpose of storing them in a small space, and also to protect them from fire and other risks. The standardisation of the sizes and various other features of microfilm and of the viewing equipment and reels employed is obviously desirable, and a new specification, B.S. No. 1371, has been prepared to provide for this. The specification was produced in co-operation with committees of the American Standards Association and agreement was reached at each stage in its preparation. We are informed that American standards which are about to be published will provide equivalents to B.S. No. 1371, so that microfilm made in the United Kingdom will be capable of satisfactory projection on apparatus made in the United States, and vice versa. The new specification covers 16-mm. and 35-mm. readers, reels, and processed microfilm, each of which is dealt with in a separate section. The essential dimensions and other features are specified and guidance is given on the arrangement of images and the sequence of pages. [Price 2*s.*, postage included.]

Copper Tubes for Use Underground.—Another new specification, B.S. No. 1386, covers solid-drawn copper tubes which are to be buried underground for the conveyance of water, town gas, etc. The tubes are standardised on the basis of outside diameter, the outside diameter selected for each size being that specified in B.S. No. 659-1944, and one wall thickness is recognised for each nominal size of tube. The specification covers copper tubes of the two following types for working pressures up to 200 lb. per square inch (460 ft. head), namely (*a*) ¼ in. to 1¼ in. nominal size in long-length coils (usually between 30 ft. and 60 ft. in length); and (*b*) ½ in. to 4 in. nominal size in straight random lengths (usually ranging between 15 ft. and 20 ft.). The quality of the material employed is related to existing British Standard specifications for copper and the new publication covers requirements concerning dimensions, the weight of consignments, and hydraulic and mechanical tests. [Price 2*s.*, postage included.]

BOOKS RECEIVED.

Statistical Methods in Research and Production, with Special Reference to the Chemical Industry. Edited by DR. OWEN L. DAVIES. Published for Imperial Chemical Industries Limited, Nobel House, Buckingham-gate, Westminster, London, S.W.1, by Oliver and Boyd, 98, Great Russell-street, London, W.C.1. [Price 28*s.* net.]

Scale Models in Hydraulic Engineering. By PROFESSOR J. ALLEN. Longmans, Green and Company, Limited, 43, Albert-drive, Wandsworth, London, S.W.19. [Price 30*s.* net.]

University of Minnesota. Engineering Experiment Station. Technical Paper No. 57. *Progress Report of Subcommittee on Methods of Measuring Strength of Subgrade Soil—Review of Methods of Design of Flexible Pavements.* By MILES S. KERSTEN. The Director, Engineering Experiment Station, University of Minnesota, Minneapolis, U.S.A.

"Ratty": A History of the Ravenglass and Eskdale Railway. By W. MCGOWAN GRADON. Published by the author, Pear Tree Cottage, Oldfield-lane, Altrincham, Cheshire. [Price 8*s.* 6*d.* net.]

Ministry of Labour and National Service. Interim Report of the Committee on the Safeguarding of Milling Machines. H.M. Stationery Office, Kingsway, London, W.C.2. [Price 1*s.* 6*d.* net.]

The Institution of Mechanical Engineers. Proceedings. January to December, 1946. Volume 154. The Secretary, The Institution of Mechanical Engineers, Storey's-gate, St. James's Park, Westminster, London, S.W.1.

Collection: Matériaux de Synthèse. Macromolécules. Volume I. *Physique et structure des Plastiques.* By PROFESSOR P. PIGANIOL. Dunod, 92 rue Bonaparte, Paris (VIe). [Price 760 francs.]

Incorporated Accountants' Research Committee. Design of Accounts. By F. SEWELL BRAY and H. BASIL SHEASBY. Second edition. Oxford University Press (Geoffrey Cumberlege), Amen House, Warwick-square, London, E.C.4. [Price 12*s.* 6*d.* net.]

A Manual of Engineering Drawing for Students and Draughtsmen. By THOMAS E. FRENCH. Revised by PROFESSOR CHARLES J. VIERCK and others. Seventh edition. McGraw-Hill Book Company, Incorporated, 330, West 42nd-street, New York 18, U.S.A. [Price 3·75 dols.] McGraw-Hill Publishing Company, Limited, Aldwych House, Aldwych, London, W.C.2. [Price 19*s.*]

PERSONAL.

PROFESSOR R. V. JONES, C.B., C.B.E., M.A., D.Phil., of Aberdeen University, Assistant Director of Intelligence, Air Ministry, during the late war, has been awarded the Medal for Merit by the United States Government.

MR. G. C. I. GARDINER, A.F.R.Ae.S., chief designer of de Havilland Propellers, Limited, has now been promoted to take charge of the design and development side of the company's activities. He fills the post hitherto held by MR. W. U. SNELL, who has relinquished his position in the company. The design and development departments are based at Hatfield, Hertfordshire.

DR. T. G. HUNTER, A.R.T.C., F.Inst.Pet., senior lecturer, Department of Chemical Engineering, University of Birmingham, has been appointed to the recently-founded Chair of Chemical Engineering, University of Sydney, New South Wales, Australia.

DR. A. H. NISSAN, F.Inst.Pet., also on the staff of the Department of Chemical Engineering, University of Birmingham, is relinquishing his position to become head of the headquarters research laboratories, Bowater Paper Corporation, Limited, on October 1.

MR. GEORGE LAWS, M.B.E., will take office as chairman of the Council of the Royal Sanitary Institute, 90, Buckingham Palace-road, London, S.W.1, on October 1.

MR. E. P. HARDY, who has been progress engineer at Acton Works, London Passenger Transport Board, since July, 1928, has now been appointed progress and planning engineer in the department of the Chief Mechanical Engineer (Railways) of the Board.

MR. F. EVERITT, A.M.I.C.E., who was promoted to the position of district engineer, London Midland and Scottish Railway, Crewe, in March, 1939, retired from that position and from the company's service on August 31.

Elections of officers have been held recently in a number of the branches of the Association of Supervising Electrical Engineers. MR. P. E. NOBLE has been elected chairman of the Bristol branch, MR. K. W. D. ROBERTS, chairman of the Coventry branch, MR. E. KING, chairman of the Lincoln branch, MR. W. G. STAINER, chairman of the Portsmouth branch, MR. W. J. SENIOR, chairman of the Stockport branch and MR. J. W. COATES, chairman of the York branch.

MR. A. WAUCHOPE FRASER, A.R.Ae.S., has been appointed secretary of the Glasgow branch of the Royal Aeronautical Society, in succession to MR. D. R. BRIANT. Mr. Fraser's address is, 39, West-crescent, Muirhead, Troon, Ayrshire.

MESSRS. STUART DAVIS LIMITED announce that their address is now Much Park-street, Coventry. (Telephone: Coventry 63091-2. Telegrams: "Machinery," Coventry.)

THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, Park House, 24, Rutland-gate, London, S.W.7, have opened a Scottish office at 18, Melville-street, Edinburgh, to facilitate closer contact with Scotland. The new office will co-operate with the Departments of the Secretary of State for Scotland, with the organisations of other Government departments in Scotland, with voluntary bodies such as the Scottish Council (Development and Industry) and individual Scottish firms. It will be in the charge of DR. H. BUCKLEY.

The Board of Trade Timber Control announce that, in the plywood department headquarters, SIR LEONARD PATON has been appointed Deputy Controller, MR. H. G. C. TOWNSEND, Senior Assistant Controller, and MR. S. C. RASMUSEN Assistant Controller.

The North Midland regional office of the MINISTRY OF WORKS has been moved to Block 4, Government Buildings, Chalfont-drive, Western Boulevard, Nottingham. (Telephone: Nottingham 77711). The regional supplies officer and the regional works transport officer, who had separate offices, have also moved to the new address.

BRITISH INDUSTRIES FAIR, 1948.—The closing date for the receipt of applications for space at the British Industries Fair, 1948, is September 20, 1947, after which no guarantee can be given that space can be made available. Application forms are obtainable from the Export Promotion Department, Board of Trade, 35, Old Queen-street, London, S.W.1, and the Birmingham Chamber of Commerce, 95, New-street, Birmingham, 2.

AWARDS TO INVENTORS.—The Royal Commission on Awards to Inventors was instituted to ascertain what sums should be paid to inventors in respect of the use made of their inventions, designs, drawings or processes on behalf of Government departments in connection with the war. Hearings are held in public in the Court Room, Somerset House, Strand, London, W.C.2, and the cases to be heard are advertised in the Daily Cause List. The next hearing has been fixed for the week commencing October 6.

NOTES FROM THE NORTH.

GLASGOW, Wednesday.

Scottish Steel.—Outputs last week suffered from one or two slight interruptions in smelting operations due to furnace troubles. The excessive heat due to climatic conditions again caused some loss of output from the rolling mills, but the tonnage of raw and finished steel was not more than 1,500 tons below the record week at the beginning of August, when some 40,000 tons of ingots and castings were produced. The demand for plates, notably thin plates, remained much in excess of supply, and allocations had to be reduced to give customers a bare ration. Sections were also very scarce, particularly small angles. The sheet trade has managed to prevent any further increase in delivery arrears, but the general indication for delivery is nine to 12 months from the placing of the order. Steel scrap is still in limited supply, and the steelworks are understood to be reducing stocks. This week anxiety was increased by the strikes in the English and Scottish coalfields, in the belief that these losses will increase the difficulties encountered in finding a coke supply for the new furnace at Clyde Iron Works. Unless this unit can be brought in and an augmented output of pig iron obtained, the scrap shortage is likely to necessitate a reduction in ingot output, regardless of whether coal supplies are maintained or not. The supply of coke is now the vital consideration.

Scottish Coal.—An outbreak of strikes in the Blantyre, Bothwell, and Stepps areas of the Central West Division last week caused a serious loss of tonnage, variously estimated at 8,000 to 10,000 tons. It is stated that the trouble reflects an increase in the activity of the Communist element known to be in the affected areas, and the stubborn opposition in many mining quarters to any attempt to alter the task to increase output. It is feared the trouble may spread, as, unless the N.C.B. are prepared to abandon all attempt to secure a full conscientious output per manshift, they must encounter even stronger opposition in the lodges. East of Scotland mining areas are unaffected. So far, supplies for current needs have been sufficient despite these losses, but restocking tonnages have had to be curtailed. House-coal allocations were better at the beginning of the week, but the improvement has not been maintained.

NOTES FROM SOUTH YORKSHIRE.

SHEFFIELD, Wednesday.

Iron and Steel.—Pig-iron production has been hindered by shortage of coke, due to the Yorkshire miners' strike. Arrangements had to be made for coking coal to be sent from Durham to keep the coke-works in operation; normally the ovens are dependent upon day-to-day deliveries. The South Yorkshire gas grid has been extremely short of coke-oven gas, and, in consequence, the Sheffield and District Gas Company has had to call upon industrial users to reduce their consumption by 50 per cent. This caused many steel-melting and heat-treatment furnaces to be shut down and reduced operations at mills and forges. All production programmes have been disorganised, and delivery dates postponed. All branches of Sheffield industry are adversely affected by the shortage of gas. Steelmakers who had installed fuel-oil burning equipment have been able to carry on with their melting operations, and, in the case of the United Steel Companies, an independent coke-oven gas supply has helped to save the situation. Some engineering works using oil-fuel have been able to carry on.

South Yorkshire Coal Trade.—The spread of the grave dispute at Grimethorpe Colliery reduced production to very low levels and made it necessary to direct supplies from coalfields outside the disaffected area. At one time there were 50 pits completely or partially idle. Only high-priority users have been able to secure supplies, and many industrial concerns have had to draw extensively upon the reserves they had accumulated for winter emergencies. Helpful assistance in the matter of supplies was afforded from outcrop workings which were pressed for fuller deliveries to industrial works and electric power stations. Gas coal has been in extremely short supply and coking coal was unobtainable in the area. House-coal deliveries have had to be considerably curtailed,

THE GAUGE AND TOOL MAKERS' ASSOCIATION.—Following the widespread adoption of the model indenture prepared by the Education and Apprenticeship Committee of the Gauge and Tool Makers' Association, the Council have decided to award, under certain conditions, a special certificate to craftsmen in the precision gauge and tool industry. Applications for the award of the certificate will be considered from toolmakers who have served a bona-fide apprenticeship with a member of the association and have passed the final examination of the City and Guilds of London Institute machinists', turners', and fitters' course. Further particulars are available on application to the secretary, The Gauge and Tool Makers' Association, Standbrook House, Old Bond-street, London, W.1.

NOTES FROM CLEVELAND AND THE NORTHERN COUNTIES.

MIDDLESBROUGH, Wednesday.

General Situation.—So great is the demand for much larger deliveries of iron and steel than are obtainable that a rise in values is unlikely to have any affect. Interest centres chiefly upon the allocation of distributable tonnage over the last quarter of the year. The fuel situation continues to occasion grave uneasiness. Much larger deliveries of coal and coke are essential to permit a substantial expansion in the production of commodities required in very large quantities for urgent home purposes and for shipment to overseas destinations. The stringent restriction of exports is unavoidable and loadings for some overseas ports have been wholly suspended. Acute shortage of pig iron and the dearth of cast-iron scrap and old machinery metal are hampering operations at consuming works, where parcels of scrap suitable for use in steel furnaces command a ready sale. Increasing imports of scrap from the Continent are a welcome supplement to the supplies from home sources.

Foundry and Basic Iron.—There is continued shortage of high-phosphorus pig iron and the whole of the output of the basic blast-furnaces is moving rapidly into direct use at the maker's own consuming departments. The local production of the former is limited, and supplies to Tees-side customers are largely from iron centres at a distance, regular deliveries from which are less reliable than has been the case for some time.

Hematite, Low-Phosphorus and Refined Iron.—The increased demand for East Coast hematite is absorbing the moderate make and producers are almost sold out for some months ahead. Firms turning out low- and medium-phosphorus grades of iron are unable to deal satisfactorily with the persistent demand for greater attention to delivery obligations as they fall due under running contracts. Manufacturers of refined iron have ready outlets for their products.

Manufactured Iron and Steel.—Makers of semi-finished iron have good orders and finished-iron firms have substantial contracts to execute. Several descriptions of semi-finished steel are needed in considerably larger parcels than manufacturers can provide and further imports of foreign products are eagerly awaited; small billets and prime sheet bars, in particular, are in strong request. The demand for all classes of finished steel is intense and is increasing. Producers are encumbered with heavy delivery obligations and obstacles to an expansion of output are formidable. The demand for black and galvanised sheets is so much in excess of the make that buyers, even with high-priorities, have to submit to long waits for their quotas. Plate producers, and manufacturers of joists, sections and rails, are extensively sold.

NOTES FROM THE SOUTH-WEST.

CARDIFF, Wednesday.

The Welsh Coal Trade.—Reports that the Government had given a pledge to the Marshall Plan conference to export about 7,000,000 tons of coal to Europe next year, together with some 6,000,000 tons of bunker coals, has been received with a great deal of interest on the Welsh steam-coal market during the past week. For some time local shippers have been pressing for the resumption of exports if only on a token scale so as to maintain contacts and goodwill. Grave doubts were felt, however, as to the ability of the district to step-up output in the time to such a pitch as to meet home demands and leave a substantial surplus for export. During the past week contracts have been signed for the supply of about 14,900 tons of bunker coals for the Merseyside, delivery to take place over the coming fortnight. The business has been placed locally because of the interruption to normal supplies caused by the Yorkshire miners' strike. Supplies of all descriptions have remained extremely scarce throughout the week. The miners' holidays, which have affected production for the past two months, have now come to an end but it was considered unlikely that the losses that have taken place in outputs would be made good. Home demand has been active again and the needs of the principal home consumers have remained heavy and provided a ready outlet for almost the whole of current productions. A steady interest was shown by some foreign users, but because of the scarcity of coals no export trade could be concluded except some limited business in the very poorest qualities intended for use in Eire. Cokes and patent fuel were well engaged.

Swansea Steel-Sheet Industry.—The market report issued by the Incorporated Swansea Exchange states that, as is usual at the approach of the end of a quarter, business in tin-plate has become more active, as home consumers are placing their orders for the next quarter. In the export market, the demand is good, but as the available supply is small, not much business has been transacted. Steel sheets continue in most insistent demand, with which makers cannot fully cope. The iron and steel scrap market is a little more active.

NOTICES OF MEETINGS.

IT is requested that particulars for insertion in this column shall reach the Editor not later than Tuesday morning in the week preceding the date of the meeting.

INSTITUTION OF PRODUCTION ENGINEERS.—*Derby Sub-Section:* Monday, September 15, 6.45 p.m., Art School, Green-lane, Derby. "Motion Study," by Miss A. G. Shaw. *Birmingham Section:* Wednesday, September 17, 7 p.m., James Watt Institute, Birmingham. "Cold Upsetting and Thread Rolling," by Mr. T. C. Parker. *Coventry Section:* Monday, September 22, 7 p.m., Technical College, Coventry. "The Effects of the Change in the Horse-Power Tax upon Motor-Car Production Engineering," by Sir Reginald Rootes. *Wolverhampton Section:* Wednesday, September 24, 7 p.m., Wisemore Schools, Walsall. "The Future Development of Machine-Tool Design," by Mr. J. H. Wilkinson.

INSTITUTE OF WELDING.—*North London Branch:* Wednesday, September 17, 7.30 p.m., Royal Society of Tropical Medicine and Hygiene, 26, Portland-place, W.1. "Some Recent Developments in the Welding of Plant for the Chemical Industry," by Mr. W. K. B. Marshall.

ROYAL AERONAUTICAL SOCIETY.—*Graduates' Section:* Tuesday, September 23, 7.30 p.m., 4, Hamilton-place, W.1. Discussion on "Design of Wings," by Mr. F. Tyson.

INSTITUTE OF METALS.—Tuesday, September 23, to Friday, September 26, Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Tuesday, September 23, 8.30 p.m., Autumn Lecture on "The Metallurgical Resources of Scotland," by Professor G. Wesley Austin. Wednesday, September 24, 9.45 a.m., various papers for discussion. 12.30 p.m., Grand Hotel, Glasgow, Official Luncheon. 2 p.m., various works visits. 7.30 p.m., City Chambers, Glasgow, Civic Reception. Thursday, September 25, 9.45 a.m., various papers for discussion. 12.30 p.m., Grand Hotel, Glasgow, Scottish Local Section Luncheon. 2 p.m., various works visits. 7 p.m., Grosvenor Restaurant, Glasgow, Dinner and Dance. Friday, September 26, all-day excursion on Loch Lomond. For programme, see page 82, *ante*.

MANCHESTER STATISTICAL SOCIETY.—*Industrial Group:* Friday, September 26, 6.45 p.m., 16, St. Mary's Parsonage, Deansgate, Manchester. "The Planning of Experiments in Industry," by Mr. R. L. Plackett.

CONTRACTS.

MESSRS. WILLIAM NICHOLSON & SONS (LEEDS) LIMITED, Leeds, have received a contract from the London Midland and Scottish Railway for the construction of tank foundations, paving and drainage at Farnley motive-power depot, Yorkshire, in connection with fuelling facilities for oil-burning locomotives.

MESSRS. G. F. TOMLINSON AND SONS, LIMITED, Derby, have received an order from the London Midland and Scottish Railway for the construction of foundations for a new 57-ft. diameter turntable on the site of an existing 42-ft. diameter turntable at Burton locomotive sheds.

MESSRS. E. C. AND J. KEAY, LIMITED, Henley-in-Arden, Warwickshire, have obtained an order from the London Midland and Scottish Railway for steelwork in connection with the renewal of engine-shed roofs at Toton, Nottinghamshire; Hasland, Derbyshire; Saltby, Warwickshire; Cricklewood, Middlesex; and Kentish Town, London, motive-power depots.

MESSRS. ASHMORE, BENSON, PEASE AND COMPANY LIMITED, Stockton-on-Tees, are constructing the first of two blast furnaces, of a capacity of 1,000 tons a day, for the new Steel Company of Wales. The furnace will supply pig iron to the large steelmaking plant and strip mill now being erected at Margam, Port Talbot. The firm's parent company, the POWER-GAS CORPORATION, LIMITED, announce that they have received from Holland a further contract, valued at 500,000*l.*, for a chemical-fertiliser plant, similar to that which they have already in hand for the Dutch State Mines, to manufacture 180,000 tons of sulphate of ammonia a year.

THE ROYAL NAVAL VOLUNTEER RESERVE.—The Admiralty announce that recruiting for the Royal Naval Volunteer Reserve Divisions, which has hitherto been confined to officers and men released from the Royal Navy, is now open to all who wish to volunteer. Those who are due for call-up on reaching the age of 18 may only join the R.N.V.R. if their call-up has been deferred for at least 12 months. If they join the R.N.V.R., on becoming due for call-up they will be guaranteed entry into the Royal Navy and be exempted from part of their new entry training, provided they have reached a satisfactory standard in the R.N.V.R. Direct entry to officer rank has been discontinued, and all men will be entered as ratings in the branch which they select. Men over 26 cannot be accepted, except in the artificer and artisan grades, for whom the upper age limit is 28.

PRE-CAST PRE-STRESSED CONCRETE BRIDGE; L.M.S. RAILWAY.

(*For Description, see Page* 263.)

FIG. 1. COMPLETED BRIDGE.

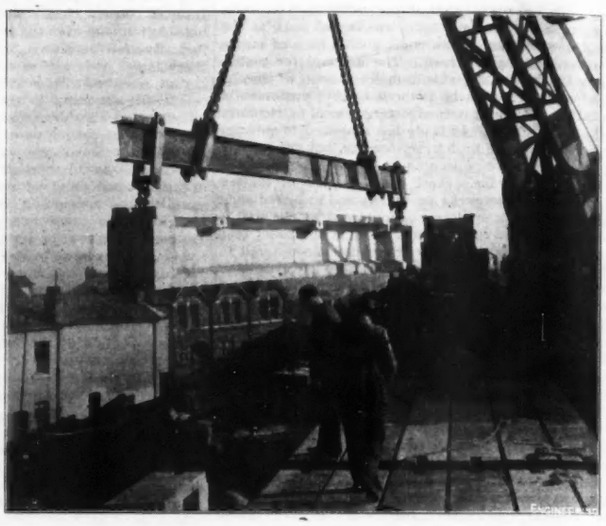


FIG. 2. ERECTING DECK BEAMS.

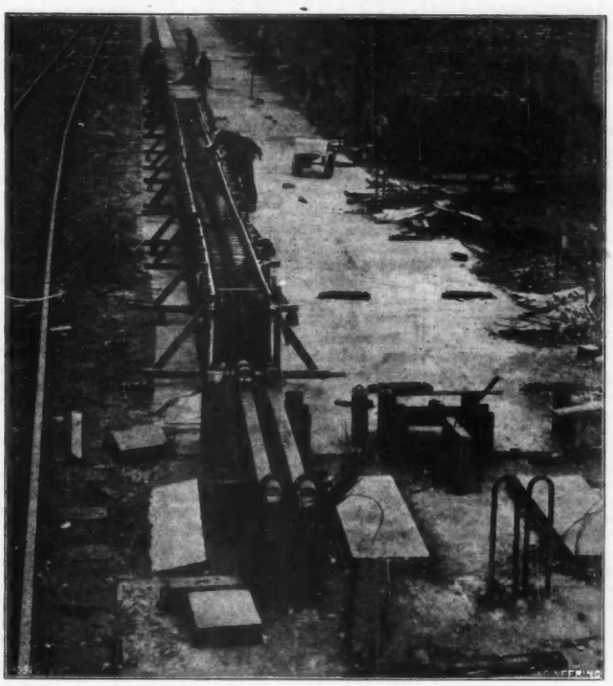


FIG. 3. CASTING BED AND STRAINING GEAR.

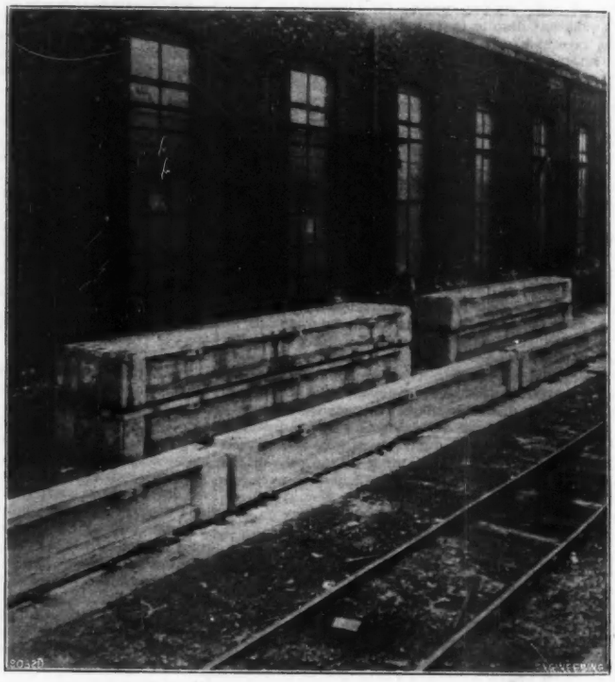


FIG. 4. FINISHED AND PARTLY-CURED DECK BEAMS.

ELECTRONIC CONTROL SYSTEM FOR ELECTRIC MOTORS.

AN electronic control system for electric motors has been designed by Philips Electrical, Limited, Century House, Shaftesbury-avenue, London, W.C.2, in order to provide a flexible variable-speed drive. It can be operated by finger-tip controls or light-current contacts, and consists of a standard direct-current shunt-wound motor, the armature and field of which are supplied from an alternating-current circuit through hot-cathode mercury-vapour rectifiers. The use of grid control enables the direct-current output of these rectifiers to be regulated so as to give any desired motor speed. The control voltage is applied to the grids automatically by an electronic control unit. The motor is then brought up to, and held at, the desired constant speed, irrespective of the load, by turning a small knob to the appropriate setting. This speed adjustment can be made before starting which, like stopping, is effected by push buttons. During the accelerating period, the current is maintained at a pre-determined maximum by the control unit, so that, if the load torque is constant, the acceleration is also constant. A dynamic braking resistor is used with full field excitation to ensure quick stopping, while the motor can be rapidly reversed by pressing a third push button. A separate control knob can be provided for reverse speeds. During the period of deceleration which occurs before reversal, energy is returned to the alternating-current mains through the rectifier. It is claimed that repeated reversals are therefore possible without the dissipation of additional energy. Inching facilities can also be provided, other buttons being fitted for this purpose. These, when pressed, cause the motor to run slowly in the forward or reverse directions until they are released. The makers state that with this system it is impossible to harm the motor by misuse of the controls or by overloading; the control unit limits the maximum direct-current, and if the motor is overloaded beyond that point it stalls.

The complete equipment consists of a transformer, switchgear panel, power rectifiers and control unit, all of which are enclosed in a single cabinet. The push-button station and speed-control knobs are separate and are connected to the cabinet by a multi-core cable. Each unit is individually replaceable, thus facilitating maintenance. The transformer occupies the lowest compartment in the cabinet, with the contactor panel above and the rectifiers and electronic-control unit at the top. It is claimed that the system is readily adaptable to special requirements, such as repetition machining and constant-speed reeling, and that the regulator is irresponsive to fluctuations in the mains voltage or frequency. Instead of push buttons, control can also be effected by limit switches, or other types of mechanically-operated switch, fitted on the machine.

ENGINEERING.

35 & 36, BEDFORD STREET, STRAND, LONDON, W.C.2.

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Telegraphic Address:
"ENGINEERING," LESQUARE, LONDON.

Telephone Numbers:
TEMPLE BAR 3663 and 3664.

All editorial correspondence should be addressed to the Editor and all other correspondence to the Manager.

Accounts are payable to "ENGINEERING," Ltd. Cheques should be crossed "The National Provincial Bank, Limited, Charing Cross Branch." Post Office Orders should be made payable at Bedford Street, Strand, W.C.2.

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"ENGINEERING" may be ordered from any newsagent in town or country and from railway bookstalls, or it can be supplied by the Publisher, post free, at the following rates, for twelve months (or for six or three months, *pro rata*), payable in advance:—

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For Canada	£4 5 0

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ADVERTISEMENT RATES.

Terms for displayed advertisements on the green art paper wrapper, on the inside black and white pages and in the buff art paper two-colour supplement, as well as for inserts, can be obtained on application to the Manager. The pages are 12 in. deep and 9 in. wide, divisible into four columns 2¼ in. wide. Serial advertisements will be inserted with all practicable regularity but absolute regularity cannot be guaranteed.

The charge for advertisements classified under the headings of "Appointments Open," "Situations Wanted," "Tenders," etc., is 8*s.* for the first four lines or under, and 2*s.* per line up to one inch. The line averages six words and when an advertisement measures an inch or more, the charge is 24*s.* per inch. If use is made of a box number the extra charge is 1*s.* per insertion, with the exception of advertisements appearing under "Situations Wanted." Series discounts for all classified advertisements can be obtained at the following rates:—5 per cent. for six; 12½ per cent. for thirteen; 25 per cent. for twenty-six; and 33⅓ per cent. for fifty-two insertions.

TIME FOR RECEIPT OF ADVERTISEMENTS.

Classified advertisements intended for insertion in the current week's issue must be received not later than first post Wednesday.

"Copy" instructions and alterations to standing advertisements for display announcements must be received at least 10 days previous to the date of publication, otherwise it may be impossible to submit proofs for approval.

The Proprietors will not hold themselves responsible for advertisers' blocks left in their possession for more than two years.

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ENGINEERING

FRIDAY, SEPTEMBER 12, 1947.

VOL. 164. No. 4259.

HIGHWAY ECONOMICS.

THE primary objects of the work conducted by the Road Research Laboratory are to improve roads as channels for traffic, to reduce costs of construction and maintenance, and to promote safety. The Laboratory works in close co-operation with the Roads Department of the Ministry of Transport. As with many other organisations, research programmes were seriously interfered with during the war, or had to be postponed, but planned long-range investigations have now been put in hand again, and as an example the work on constructional methods being carried out in conjunction with the Cement and Concrete Association may be mentioned. In the present labour and financial position, the immediate prospect for extensive reconstruction of existing roads, or the building of new ones, is not promising, but the inevitable postponement does at least furnish an interval in which research may be extended and intensified.

This delay is a by no means unmixed blessing, as there is no question that present knowledge of road layout, if it could be put into practice, would do much to reduce the present deplorable total of death and injury on the roads. All accidents are not due to the physical features of the roads, but a substantial proportion are, and perhaps even a larger proportion of those attributed to human error or carelessness could be eliminated by the adoption of arrangements and layouts imposing physical controls which would render some of the careless or foolhardy activities impossible. It was only in 1946 that the terms of reference of the Road Research Board were extended formally to include the subject of road safety, but actually this matter has been implicit in its activities from the first. It is not possible to separate considerations of traffic flow from those concerning road safety; dual carriageways and roundabouts at busy crossings serve both ends. There are, however, many problems of road safety which cannot be solved under present conditions by modifying the physical layout of roads, and this state of affairs is likely to continue for many years. Many of these problems have to be dealt with by educating the public and enforcing regulations. Presumably, activities directed to these ends will now come within the scope of the Road Research Laboratory. This is all to the good, but problems involving intractable human nature, and frequently with special local characteristics, may be investigated profitably by a multitude of bodies, as to some extent, they are.

In the design of a new road, it is necessary to study the volume and type both of the immediate and the potential traffic, to consider its relation to existing roads, to determine the layout in terms of the safety both of drivers and pedestrians, and to decide on the materials and method of construction, which may be dictated to a considerable extent by local conditions. The whole of these matters together constitute the broad subject of highway economics. This expression is usually employed in a more limited sense, and in a recent report* issued by the Road Research Laboratory, it appears to be restricted to questions of cost of construction and useful life, attention being paid to such aspects in the design as may influence the cost of improvements or alterations which the growth of traffic may make necessary.

Improvement in the safety of a road by proper attention to the physical control of traffic is, however, a matter of details of design and the fundamental question facing those who have to lay out a new road, or improve an old one, is that it shall be properly adapted to the traffic to be carried. For this purpose the designers must be provided with the results of extensive traffic studies. It is to be feared that in many cases such results are not available in this country. The situation is apparently very different in America and the report of the Road Research Laboratory states that in that country a large proportion of the funds available for road research is spent on the study of traffic problems. Those funds are evidently large, as in addition to the work conducted by the Public Roads Administration of the Federal Government, many individual States have research organisations of their own and various trade associations are also active in the matter. The report has been prepared to give an account of the information gathered during a visit of a delegation from the Road Research Laboratory to the United States and Canada to study the methods being employed in connection with road research and the results being obtained. The delegation consisted of Dr. W. H. Glanville, the Director of the Laboratory, and Mr. F. N. Sparkes, the head of the concrete section.

As already mentioned, a large proportion of the total funds available for road research in America is devoted to traffic studies. Counting the number of vehicles utilising a selected road over a definite period is common practice in Great Britain, but something much more elaborate is practised in the United States. In a general survey, 18 counts, each of eight hours' duration, were made at key stations. The counts were spread over a year and included different days of the week and seasons, and times of the day. The whole survey took two years and employed 5,000 men. This elaborate investigation is far from representing the full extent of the traffic studies which have been carried out and many special investigations have been made; one, for example, covered the weight of commercial vehicles passing 150 selected locations. An investigation in New Mexico showed that heavy traffic between two towns preferred a route 25 miles longer than the nearest way because of a better road surface. Analyses showed that a saving of 89,000 dols. a year would result from the provision of a good direct road between the two towns, at a cost of 350,000 dols. An important study concerned the proportion of the total traffic approaching a town which passed through without stopping. Knowledge of this is necessary when it is desired to ascertain if the construction of a by-pass would be justified. It was found that the proportion of through traffic was determined by the size of the town; with towns of a population up to 2,500 it was more than 60 per cent., but with towns of over 500,000 inhabitants the corresponding proportion was less than 10 per cent.

The report contains a section dealing with road layout. Doubtless, lessons applicable in Great Britain may be drawn from American practice, but

* *Impressions of Roads and Road Research in North America.* London: H.M. Stationery Office. [Price 1*s.* 6*d.* net.]

there are two important differences between the conditions in the two countries. There is a comparative absence of pedal cyclists in America and lorries and coaches, so far from being restricted in speed, are encouraged to travel at similar speeds to private cars. It is argued that it is not only uneconomic to restrict the speed of commercial traffic, but that slow-moving vehicles are the cause of accidents owing to fast-moving vehicles drawing out to overtake them. The American Association of State Highway Officials consider that rural roads should be designed for a desirable speed of 70 m.p.h. This naturally requires that sight distances should be adequate. On a 70-m.p.h. two-lane highway the minimum sight-distance at which overtaking is permissible is 2,900 ft., the corresponding distance for a three-lane road being 1,800 ft. This matter of sight distances might well receive much more attention in this country. Great improvement could be made at many places at comparatively small expense. In a paper read before the Public Works, Roads and Transport Congress on July 22, Mr. G. T. Bennett, County Surveyor of Oxfordshire, stated that improvements of vision at 58 road junctions in the county, by cutting back hedges and walls, or modifying the angle of entry, resulted, in four years, in a reduction of the fatal-accident rate by 76 per cent., and of the total-accident rate of 32 per cent.

Although a section of the report appears to restrict the term "highway economics" to questions of cost and maintenance, it appears that the wider meaning of the expression, which has been adopted in this article, is well understood in America. Attempts have been made to determine the cost in monetary terms of vehicle operation, as influenced by road conditions. Gradients, imposed speeds and other local features form items in the computation, a further important factor being the accident-expectation rate. The cost of accidents has been variously estimated; in Oregon it is placed at 5,000 dols. for an accident resulting in death, 500 dols. for cases of injury, and 100 dols. for material damage. With the high speeds practised and contemplated, it is clear that the width of traffic lanes is of importance; 10 ft. was at one time a standard, but 11 ft. is now common, with 12 ft. on roads with a high traffic density. It is stated that the injunction "traffic should keep to its own lane" is strictly observed in most States, although in some "conditions are much the same as in Great Britain."

In spite of the care with which road problems are studied in America and the great attention paid to questions of layout, the road-accident position is very serious. In 1944, 24,300 people were killed on the roads and 850,000 injured; these figures are about two-thirds of the pre-war records. Direction and warning signs are extensively adopted, but a grave weakness in the whole position lies in the fact that each State is responsible for its own traffic regulations, so that the arrangements adopted vary widely in different parts of the country. In some cases, instructions of a type which might usefully be copied in this country are employed. An example is furnished by a notice indicating a zone in which overtaking is not permissible. Such notices are not unknown in Great Britain, but usually they are not very prominent and do not form a standard item in the road-sign system. Another type of notice, which is commended in the report, indicates the safe speed at which a curve can be traversed.

It is stated that traffic signals vary so much from place to place that it was sometimes difficult to recognise them. Pedestrian signals of the "cross now" type appear to be common. Suggestions are frequently made in this country that crossing the road at unselected points should be made an offence, but it has always appeared that such a rule would be difficult, or impossible, to enforce. In Dayton, Ohio, "pedestrian offenders are sent to a traffic school; a second offence may result in a fine." Dayton has a population of some 200,000, and is thus a fairly large town, but whether its practice could be successfully copied in London is doubtful. The first step would have to be a great extension in the equipment of pedestrian-control signals.

THE ORGANISATION OF LOAD SHEDDING.

THE announcements that it might be necessary to "shed" electrical load, which have been made recently, have probably received little attention from a public harassed as it is by other threats of austerity. They are, however, an indication that the shortage of generating plant, of which we were warned in the early part of the year, still persists; and that, even if adequate coal supplies are available during the coming winter (as at the moment seems unlikely) it will be necessary forcibly to limit the demand at times of peak load. It is estimated, in fact, that in January, 1948, the plant available will be capable of meeting a demand of only 9,530 MW at standard frequency, but that the corresponding aggregate of area maximum demands will be 9,742 MW. A deficiency of about 200 MW will therefore have to be provided for. This deficiency can, of course, be met in two ways: either by spreading the demand by some form of "staggering" working hours or by cutting off a proportion of the load when the danger point is approached. The former method, if and when applied, may do something to relieve the situation, but it is clear that resort will also have to be had to the latter.

This being the position, it is desirable that such load shedding as may be necessary should be carried out so that it causes the minimum of inconvenience. The conditions that must be fulfilled to accomplish this are that undertakings shall be given some indication of the maximum loads they will be permitted to carry; and that the instructions to shed load shall be issued as far as possible in advance, so that the abrupt switching off which on occasion occurred last winter can be avoided. Various schemes for solving these difficulties have been considered during recent months by the Central Electricity Board, in conjunction with the Electricity Commissioners and the Electricity Supply Joint Committee. As a result, a scheme has been evolved by which each undertaking will be given a target maximum demand to which the load must be reduced when appropriate instructions are given by the Central Electricity Board. The details of this scheme appear in a memorandum, in which it is pointed out that among the objections to the procedure adopted last winter was the impossibility of discriminating between undertakings with a large industrial load and those carrying loads which were mainly domestic. There was also a lack of discrimination between undertakings and consumers who had or had not made voluntary reductions. Moreover, no prior indication was given of the probable magnitude of the cuts, or, conversely, of the individual maximum loads which might be accepted. This lack of information prevented undertakings from making their own plans to minimise dislocation.

To ensure the satisfactory operation of such a scheme it is necessary for care to be taken in determining the target maximum demands upon which it depends. After considerations of certain alternatives, the demands during November and December, 1946, were taken as a basis, and undertakings were asked to give the percentages of the peak loads recorded during those months, which were due to public lighting and traction, industrial consumers and general consumers, respectively. They were also asked to state the additional industrial load which they expected to connect by the winter of 1947-48. Meanwhile, the Government have laid down that the maximum industrial loads recorded last winter are to be reduced by 33⅓ per cent. It is, however, considered that it would be unwise to assume, in preparing a scheme of target loads, that such a reduction will be achieved, especially as there is an appreciable proportion of continuous process work on which no reduction is practicable. The target peak loads for January, 1948, have therefore been calculated on the assumption that the public lighting and traction loads will be met in full, that the estimate of the industrial load in January, 1948, will be reduced by 20 per cent., and that the domestic load in the same month shall not exceed by more than 10 per cent. that recorded in November-December, 1946.

The memorandum justifies this bias against the industrial consumer by pointing out that when there is no fuel shortage the demand of the general consumer is substantially higher in January-February than in November-December, while the industrial demand remains nearly constant. Moreover, in assessing the industrial component of the proposed target full allowance has been made for anticipated new loads; and these amount to more than 10 per cent. of the industrial contribution in November-December, 1946. On the other hand, no specific allowance has been made for the increase in general demand, such as will have been brought about by re-housing. Finally, the total allocation of kilowatts for general consumers represents a reduction of 12 per cent. on the undertaking's estimates. General consumers also include such places as hospitals and sewage-disposal works, the demands of which cannot easily be reduced. This class of the population, therefore, cannot be said to have been freed from the risk of austerity, especially if the winter is severe.

We understand that the preliminary target figures resulting from these calculations have now been received by the undertakings. Adjustment of them to meet local circumstances, however, may be allowed so long as the overall target allotted to each area is not exceeded. Correspondingly lower targets will also be laid down in months other than January to allow for the reduced availability of generating plant. As before, the local arrangements for reducing load will be in the hands of the individual undertakings. It is suggested, however, that industrialists who have already made arrangements for load staggering should be immune from shedding as far as possible. It is also indirectly recommended that the network might be divided into five sections, one of which is switched out in rotation on each working day. Voluntary co-operation is enlisted, although it is made plain that recalcitrants will lay themselves open to drastic measures.

The scheme which we have outlined above is not without its theoretical and practical complications and, as such, is hardly likely to receive universal acceptance. It will bear most harshly on the consumers, industrial or general, in areas where the proportion of "continuous processes" is high and least harshly in those where there has been little or no addition to the load during the last twelve months. It will not, therefore, fulfil the ideal of "equality of sacrifice." On the other hand, its success or failure will depend on the extent to which the public realise its necessity and determine to give it a fair trial. With the price of coal increasing and the difficulty of ensuring its regular delivery certainly not becoming less, there will, however, be a growing temptation to turn more and more to electricity for space heating. That temptation is less likely to be resisted now that it has been announced by the Ministry of Fuel and Power that compulsory restrictions on domestic consumers are unlikely. If that be so, and the weather should prove unfavourable, this hope may not be realised and the domestic consumer may have to endure further restrictions, in addition to the rigours of a "currentless" day.

As pointed out by *The Economist*, the authorities now have a formidable array of instruments for imposing power cuts. They include a Statutory Order to enforce staggered hours, targets for the electricity undertakings, and various other schemes and plans for spreading the load and ironing out the peaks. It is to be hoped that in the administration of these mercy will be combined with necessity, and that care will be taken to ensure that the comparative mildness of the directives from the central authority are not "gingered up" by the misguided enthusiasm of local officialdom. A final reflection is that what is being suggested is at best a palliative for a state of affairs which would not have arisen had reasonable foresight been exercised, and if the advice of those who knew the position had been taken when it was offered. It is to be hoped, therefore, that the ingenuity which has been exercised in producing these schemes will not be allowed to obscure the fact that new generating plant of adequate capacity to deal with legitimate demands must be provided without delay if the industrial position is to be recovered and developed.

NOTES.

THE FUEL ECONOMY CONFERENCE.

THE Fuel Economy Conference now in session at The Hague is the eighth sectional meeting of the World Power Conference to be held since the parent conference was inaugurated in 1924, and is the first since the conclusion of hostilities, the previous meeting having been that at Vienna in 1938, which dealt with agricultural engineering, small-scale industries, public lighting, and railways. It follows, therefore, that there was a wide field to be covered in drawing up the programme; so wide, in fact, that the discussions so far, while of much technical interest, have tended to seem rather diffuse. While this is probably inevitable, the proceedings otherwise have been remarkable for the friendly atmosphere inspired from the outset by the members of the Netherlands National Committee, who have achieved conspicuous success in organising the numerous functions included in the programme and in surmounting the difficulties inseparable from the long German occupation of their country. The Conference, which began on September 2 and terminated, so far as the technical sessions were concerned, on the afternoon of September 9, was opened at a general meeting in the historic Ridderzaal, at The Hague, with an address by the chairman, Mr. G. J. T. Bakker, Director-General of Energy Supply in the Dutch Ministry of Economic Affairs. Mr. Bakker introduced to the meeting the Minister of Economic Affairs, Dr. G. W. M. Huysmans, who made the members welcome on behalf of the Netherlands Government. His Excellency's remarks having been suitably acknowledged by the leading official delegates among the spokesmen of the score or more of nations represented, a short lecture on "Atomic Energy for Peaceful Purposes," was delivered by Professor G. J. Sizoo in the absence, through illness, of Professor H. A. Kramers, who was to have spoken on this subject. It was well known, said Dr. Sizoo, that the release of nuclear energy placed at the disposal of mankind a new and enormous source of power, the potentialities of which for the destruction of culture and of life had been amply demonstrated; but, instead of closing this new power source as hastily as it had been opened, in order to avoid its further destructive application, Man must accept the profound responsibility of controlling its development to ensure that, in future, it should be used constructively. In the near future, the production of atomic power for industrial purposes seemed fairly certain, but there was no reason to suppose that the old-established sources of energy would become obsolete as a result. The amount of uranium in the earth's crust was probably some 40 times the amount of silver, but the ores which were concentrated sufficiently to be worked economically were relatively scarce. Even so, however, they would probably suffice to provide 50 times the present total consumption of power in the world.

FLYING DISPLAY OF BRITISH AIRCRAFT.

The Eighth Flying Display and Static Exhibition, organised by the Society of British Aircraft Constructors, opened at the Radlett aerodrome of Messrs. Handley Page, Limited, on Tuesday, September 9. The exhibition will be open until to-day, but the flying display was held on the first three days only, the object being to leave the last day free for the examination of the aircraft by technicians of the aircraft industry and Government departments. Altogether, some 5,000 visitors were entertained on the first day and this figure included representatives of the Governments and aircraft industries of 45 countries. In a speech welcoming the guests, the President of the Society, Mr. W. R. Verdon Smith, referred to the high place which Great Britain claims to occupy in the field of aircraft engineering, a claim he considered justified by the wide variety of exhibits, ranging from the raw materials to the finished product. Mr. Verdon Smith went on to point out that, in one respect, they had been unable to meet changing circumstances as they were again unable to open the Exhibition to the general public. Unfortunately, no suitable aerodrome within easy reach of London could be found, but although he deplored this difficulty, he pointed out that the Exhibition was primarily for trade purposes; nevertheless, he hoped that the time would come when the public might be admitted. After welcoming the guests, Mr. Verdon Smith referred to civil aviation. In this field, he said, there was the usual din of battle and the usual abuse was being heaped by everyone on everyone else, and although in the intensity of present competition such excesses were to be expected, they had the effect of obscuring the true position. British operators had made great strides and, so far as the future was concerned, he had every confidence in the new designs. Mr. Verdon Smith concluded his speech by extending an invitation to the guests to follow up their visit to the Exhibition by visits to the various works. The Society held the first exhibition of this kind in 1932 and this is the second time that it has been held at Radlett. More than 70 of the latest British military and civil aircraft are on view, ranging in size from the Avro Tudor VII and Handley Page Hermes II four-engined civil air liners, to small communications machines and gliders. The static exhibition covers an area of 63,000 sq. ft. and is the biggest yet arranged at the Show. It houses 187 stands on which British manufacturers are showing a wide range of aviation equipment, from complete engines to the smallest components.

THE JUBILEE OF THE ELECTRON.

The jubilee of the discovery of the electron by Professor (later Sir) Joseph J. Thomson, as announced on page 387 of our issue for May 9, 1947, will be celebrated jointly by the Institute of Physics, the Physical Society and the Institution of Electrical Engineers, towards the end of the present month. On Thursday, September 25, at 2.30 p.m., a meeting will be held at the Royal Institution, Albemarle-street, London, W.1, at which, after an introduction by the President of the Institute of Physics (Professor A. M. Tyndall), lectures on "The History of the Discovery of the Electron and the Early Developments," and on "Electrons in Modern Theoretical Physics," will be delivered by Professor J. A. Crowther and Professor A. Peierls, respectively. On the evening of the same day, an experimental lecture, entitled "The Electron Liberated," which is intended for the general public, will be delivered at the Central Hall, Westminster, London, S.W.1, by Sir Clifford C. Paterson. On Friday, September 26, a lecture on "The Electron in Research," will be delivered at the Institution of Electrical Engineers, Savoy-place, Victoria-embankment, London, W.C.2, by Sir George Thomson, the meeting beginning at 10 a.m., and this will be followed at 11 a.m. by a lecture on "Electrons in Industry," by Dr. T. E. Alibone. At 3 p.m. in the afternoon of this day an exhibition of early apparatus and subsequent developments will be opened officially at the Science Museum, South Kensington. This exhibition will remain open to the public until December, 1947. In the evening, a dinner for members of the three participating bodies and their guests will be given at the Savoy Hotel. The Institution of Electrical Engineers is also taking steps to remedy the fact that it has no suitable memorial to J. J. Thomson and his great work by commissioning Mr. Francis Hodge to undertake a posthumous portrait. In due course, this will be hung in some prominent position in the Institution building. It may be recalled that before Thomson's discovery, which was first announced at a lecture before the Royal Institution on April 30, 1897, cathode rays had been extensively studied for some 15 or 20 years. It was his genius, however, which enabled him to grasp what was important in the confusing and contradictory clues which experiment had made available; and to carry out the final experiment, which demonstrated beyond all reasonable doubt, that cathode rays consisted of negatively-charged particles all alike and all much smaller than the smallest particle hitherto known to science—the atom of hydrogen. It is typical of the magnitude of Thomson's genius that in this lecture he also foreshadowed the electron theory of matter, which has dominated physical research for the past 50 years.

LOCOMOTIVE-TESTING STATION AT RUGBY.

The London Midland and Scottish Railway Company and the London and North Eastern Railway Company jointly announce that they hope to complete, by about the middle of 1948, the locomotive-testing plant at Rugby, the construction of which was commenced in 1937. No information on the design of the station, beyond what Sir William Stanier, F.R.S., gave in his presidential address to the Institution of Mechanical Engineers in 1941 (see ENGINEERING, vol. 152, page 377 (1941)), is available at present, but the joint announcement indicates that the station will embody the principal features of similar plant in other countries, notably that at Vitry-sur-Seine, near Paris. The station, which was to have cost 150,000*l.*, but will now doubtless cost much more, was well advanced by the autumn of 1939 and would have been completed in 1940, but work was suspended owing to the war. A contract for the testing apparatus had been placed with Messrs. Heenan and Froude, Limited, Worcester, who sub-contracted with Messrs. A. J. Amsler and Company, Schaffhouse, Switzerland, for the dynamometer equipment. The buildings at Rugby are now being completed, some of the machinery is being installed, and it is hoped to receive the equipment from Switzerland in October. Although the first plant on which a locomotive could be tested when running on its driving wheels came into operation at Purdue University in 1891, and several others were built subsequently, notably in the United States, Germany and France, the railway companies and locomotive builders of this country—the pioneers of locomotive construction—have never been provided with a suitable testing plant. The Great Western Railway Company's plant at Swindon, which was erected in 1905, has a capacity of only 500 h.p., and is not suitable for testing modern locomotives. The late Sir Nigel Gresley, who was largely instrumental in establishing the need for a testing station, said: "This country cannot afford to rest on its past achievements, and it is rather humiliating to have to admit that when we require technical data in connection with locomotives, we have to rely on experiments made in other countries where locomotive testing has developed to a greater extent than it has done here." That was in 1931, in a paper before the Institution of Mechanical Engineers on "Locomotive Experimental Stations." A few years before, Sir Nigel, and others, had made representations on the matter to the Department of Scientific and Industrial Research, and, as a result, a committee, under the chairmanship of the late Sir Alfred Ewing, was appointed in 1928 to consider and report on the question. The committee reported favourably and submitted plans which were mainly the joint work of Sir Nigel and the late Sir Henry Fowler. However, the economic situation at that time was not conducive to such projects, and, as already noted, it was not until 1937 that construction was commenced. Owing to that delay, and the delay caused by the war, the opening of the station for the improvement of the steam locomotive will evidently coincide, within a year or so, with the introduction of Diesel-electric and gas-turbine locomotives for heavy express traffic on the four main-line railways. Whether or not the station is also used for these new forms of motive power, it will nevertheless be of inestimable benefit for improving existing classes of locomotives and designing new classes. It will enable the staff to isolate many of the variables which affect the performance of a steam locomotive and which are so difficult to study on the track, and it will be complementary to the dynamometer cars which have provided most of the test data in the past.

THE TESTING OF HIGH-VOLTAGE CIRCUIT BREAKERS.

When the high power testing laboratory of the General Electric Company at Witton was planned in 1930, the requirements of this country could be met by plant capable of testing circuit breakers with rupturing capacities up to 1,500 MVA at 132 kV. At the present time, circuit breakers with rupturing capacities of 2,500 MVA at 132 kV are already required, while ratings of 3,500 MVA or 5,000 MVA at 264 kV may be necessary within the

next few years. Abroad, schemes are in hand, which may necessitate the employment of even higher ratings. The fundamental laws governing arc extinction, however, are still only vaguely understood. The design of circuit breakers has therefore to be based upon experience. In fact, the only sure way of proving the performance of a circuit breaker is to make rupturing capacity tests up to its full rating. This being so, it is essential to correlate the capacity of the testing laboratory with circuit-breaker production and, since research and development work must precede this production, to consider the short-circuit output of the testing equipment in relation to future design requirements. It has been decided, therefore, to increase the output available at the Witton laboratory to a considerable extent, particularly at the higher voltages. To do this, a second alternator is to be installed with its own super-exciter, which, when run in parallel with the existing machine, will enable a short-circuit output of 4,000 MVA to be obtained. Additional reactors to regulate the short-circuit currents obtainable are also being installed, while for high-voltage tests six further transformers are to be erected. This new plant will provide more than twice the output obtainable at present at the higher voltages. The available voltage will also be increased, so that it will be possible to test 264 kV circuit breakers with ratings of 3,500 MVA. Going a step farther, if voltages exceeding 264 kV are required, multi-break designs will be employed and, since such circuit breakers can be tested in sections, it will be possible to obtain short-circuits equivalent to ratings exceeding 5,000 MVA.

Longmoor Military Railway.

Regiments were often compelled to relinquish their depots owing to the exigencies of the war, but the Transportation Branch of the Corps of Royal Engineers is fortunate in having a home which is as static as anything with which the Army is likely to encumber itself. The home is the Transportation Training Centre, at Longmoor Camp, Hampshire, where the Longmoor Military Railway, with running sheds, workshops, signal school, steam and Diesel locomotives, and carriages and wagons, is available for training the officers and tradesmen who run the railways, ports, and inland water transport for the Army. The L.M.R. is eight route miles in length, and with a double-line section in one part, a loop known as the Hollywater branch, and the numerous sidings, etc., the total track mileage amounts to over 60. The Training Centre, which was founded early in the century, held its first "At Home," to which members of the public were invited by the War Office, on Wednesday, September 3, 1947; and the Commandant, Brigadier R. Gardiner, C.B.E., and his staff, had arranged a display which presented a unique opportunity to most of the visitors to gain an insight into railway working. Drivers and firemen, platelayers, blockmen (corresponding to signalmen), fitters, turners, moulders, welders, and many other tradesmen were to be seen at their work, and there were informative exhibitions of vacuum brakes, Westinghouse brakes, wheel-dropping, tube-cleaning, washing-out; and models and photographs of examples of the war work of the Transportation Branch. In welcoming representatives of the Press, Brigadier Gardiner referred to the visits of members of the Junior Training Corps and Army Cadet Force, and stressed the fact that all the trades taught at the Centre corresponded to the equivalent trades on civilian railways. All regular sappers do normal field engineering training, but some may specialise in transportation by attending a course at the Centre. Officers are given a valuable two-year course consisting of a year at the Centre and a year with civilian railways and ports. The Commandant said that the Training Centre was responsible for the administration and training of the Supplementary Reserve units, which formed the peace-time nucleus of the Transportation Branch, and they were hoping to recommence annual training for these units next summer. During the war, transportation stores were established at Longmoor, which increased the track mileage and improved the training facilities. There is also a wing at Marchwood, near Southampton, for training officers and men in port operating and construction, railway bridging and inland water transport.

THE BRITISH ASSOCIATION MEETING IN DUNDEE.

(*Concluded from page* 233.)

Hydro-Electric Developments in Scotland.

The members re-assembled on Monday, September 1, to hear the paper by Mr. J. Henderson, M.C., B.Sc., M.I.E.E., on "Hydro-Electric Developments in Scotland," the President of the Section, Sir William Halcrow, occupying the chair. Mr. Henderson duly presented his paper, which we hope to reprint in a subsequent issue of ENGINEERING. The only speaker on this paper was the chairman, who pointed out that, in the early days, the development of hydro-electric power in the Highlands had been due to private enterprise, beginning with the efforts of the British Aluminium Company, at Foyers, and proceeding to the Kinlochleven and Lochaber plants. After the 1914-18 war, private enterprise had provided electricity for general users, undertaking the Clyde Valley, Grampian and Galloway schemes, all of which had been very successful. The position had now changed. Since 1943, when the Hydro-Electric Development Board was set up, the disabilities under which private enterprise worked had disappeared. One of the arguments that had been used against the schemes in the north was that the Highlands must not be made the power-house of the Lowlands. To-day, however, that was an accepted fact. The principal advantage of electricity generated from water power was that the cost per unit of electricity was known. It was known also that the cost could never be any higher, and that it would gradually decrease. This fact was not always fully recognised. With coal-produced power, the cost in the future could not be determined. When the Glen Affric scheme was first planned, 31 years ago, the energy was to cost 0·1*d.* per unit, whereas to-day the cost would be nearer 0·2*d.*, but even with this increase, it was much below the cost of electricity from a steam power-station. For these reasons, Sir William thought that the Scottish Hydro-Electric Board should go ahead with the development of every scheme which was at all practicable.

The Resistance-Capacitance Oscillator.

The next paper taken was one by Mr. P. G. M. Dawe, B.Sc. (Eng.), dealing with the mechanism of oscillation in phase-shift oscillators. Mr. Dawe presented his paper, which we hope to reprint later, and the only speaker on it was Mr. L. Bainbridge-Bell, who said that in these days, when non-mathematical people had to be instructed in the working of complicated electronic gear, it was pleasing to hear a practical and non-mathematical description of the physical processes involved. The author agreed that it was useful to be able to visualise the physical processes.

Creep and Shrinkage in Reinforced Concrete.

The third and last paper on the programme for the Monday morning session was one by Mr. H. B. Seed, on the effects of creep and shrinkage in reinforced-concrete structures, its object being to compare the methods of calculating the magnitude of these effects which have been put forward, and to compare their relative merits with a view to their incorporation in routine design procedure. Mr. Seed duly presented his paper, which will be reprinted later, and the first speaker in the subsequent discussion was Mr. J. T. T. Dillon, who referred to cracks which had appeared in the concrete of the Assouan Dam, but, apparently, had no effect on the strength of the structure. The only other speaker on this paper, Professor A. D. Ross, said that shrinkage in reinforced concrete had been recognised for many years, and at first engineers had been very perturbed about it. Their misgivings, however, had been unfounded. The work done by Mr. Seed and others was necessary, because the effects in reinforced concrete must be understood before designing methods could be altered. The classical theory, even with the best modular ratio—if there were such a thing—was only a crude approximation, because even the right modular ratio could only be right at one moment in the life of the structure. In other countries the classical theory had been abandoned, as it had been, to a limited extent, in the D.S.I.R. code with regard to columns. He asked the author if the time had not come to abandon this theory, which was only a rather clumsy artifice, and to design reinforced-concrete structures on the basis of their ultimate strength. In reply, the author agreed with Professor Ross. He thought the plastic theory of design should be employed, but his paper had been intended for those who insisted on using the present-day method of design. If the modular ratio were used, however, it must be the right one. He thought it preferable to change to the plastic theory, in which case the modular ratio was of no importance.

As the President, Sir William Halcrow, would be unable to take the chair at the next day's meeting, Mr. J. S. Wilson proposed a vote of thanks to him for having conducted the proceedings to that point. The vote was carried by acclamation and, after a suitable acknowledgment by the President, Mr. N. T. Carne gave a brief description of the new works of the National Cash Register Company, at Camperdown, near Dundee, which the members of the Section were to visit that afternoon. Another party visited the Dundee Corporation electric power station at Carolina Port on the Tay, where a 30,000-kVA turbo-alternator set has been installed recently, together with the necessary boiler plant. The meeting was then adjourned until the following day.

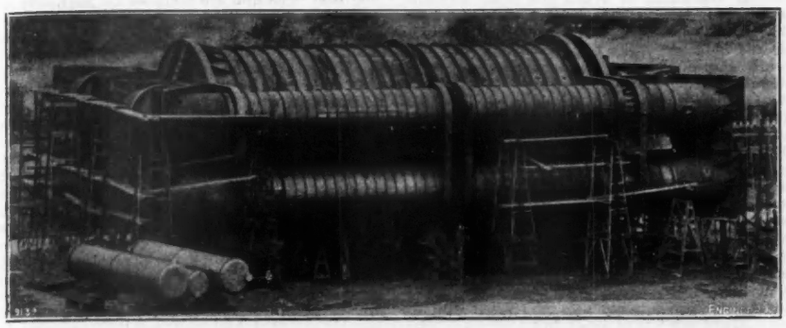
Mechanisation of Collieries.

Mr. J. S. Wilson, Past President of the Section, occupied the chair at the meeting held in the morning of Tuesday, September 2. The first paper taken was one by Mr. Forrest S. Anderson, dealing with the mechanisation of collieries and referring particularly to coal-cutting machines. The paper will be reprinted in a subsequent issue of ENGINEERING. A brief discussion, in which several members took part, followed the reading of the paper. In reply to a question, the author explained the method by which coal-cutting machines were hauled. Long-wall machines, he said, were of the skid type and incorporated a haulage drum round which was wound a rope anchored to the coal face. Rotation of the drum by gearing caused the machine to slide along on its base to the required position. Formerly, the machines were mounted on wheels running on rails, but these were found to be unnecessary. Explaining a reference in the paper to the 24-hour cycle, Mr. Anderson said that the cycle comprised three eight-hour shifts, two of which were occupied in preparatory work and one with actual coal-getting. Mr. D. H. McPherson asked for an explanation of a reference in the paper to the face being "blown," and the author said that after the coal had been undercut, holes were drilled in the upper part of the seam, and an explosive charge was inserted in the hole and fired to break down the coal. Specially-trained men superintended this operation. Dr. R. V. Southwell inquired whether pneumatic drills were employed, and the author said that hand drills, pneumatic drills and electric drills were used, the last-mentioned being the most common. The use of electricity, however, was not permitted on all faces and in these cases pneumatic drills of the rotary or percussive types were employed, the rotary type being generally preferred.

In response to a request by Mr. J. S. Wilson, the author gave a more detailed explanation of the room-and-pillar method of mining, and Mr. D. B. McLay asked for information on methods of limiting the damage to the ground surface due to this method of working. Mr. Anderson agreed that this was an objection to the room-and-pillar method. In long-wall working, he said, packing was always done, so that less damage was caused by this method. In some cases, however, where mining was carried on under valuable property, it was not possible to work the long-wall system with the orthodox packing, but permission was given for partial extraction, and the room-and-pillar method might then be used without extracting the pillars. Mr. H. Swan inquired how shots were fired in faces at which the use of electricity was not permitted, and Mr. Anderson replied that in such places shot firing also probably would not be allowed; the coal would then have to be obtained by hand picks. The use

AIRCRAFT-TESTING CHAMBER.

MESSRS. VICKERS-ARMSTRONGS LIMITED, LONDON.



of electricity, however, was allowed even in gassy mines, provided that the percentage of gas in the air was below a certain figure. In some cases, shot firing was permitted only at the end of the night shift. Wing-Comdr. Cave-Browne-Cave asked whether coal-cutting machines produced more or less dust than hand methods of winning coal. This, the author answered, was a controversial matter. Explosives made a great deal of dust. Mechanical "gummers" had been introduced in connection with coal-cutting machines to ensure that the undercut was effectively cleared of debris. Originally, this had been done by hand, using long shovels, but gradually the work had been omitted, leaving the cuts full of "holings," with the result that a great deal of dust had been caused.

FUTURE ORGANISATION OF SECTION G.

On the conclusion of the discussion on Mr. Anderson's paper, Dr. R. V. Southwell took the chair, and before proceeding to the presentation and discussion of the two papers remaining on the programme, raised the question of the organisation of the Section at future meetings of the Association. Dr. Southwell said that it had been the endeavour to organise the Section so that the meetings were of the maximum use to young men. The plan underlying the programme was to begin each morning session with a one-hour paper, which could be described as an authoritative review of practice, and to follow that with two shorter papers of a miscellaneous character prepared by younger members. The British Association meetings, he said, afforded an ideal opportunity for young men to acquire practice in "putting over" papers to fairly large audiences and joining in discussions. This practice had continued for several years in Section G., and had attracted interest in other sections and in the Council of the Association. That afternoon a discussion was to be held between the President and the student-exhibitioners at which there would be an opportunity for the younger members to make suggestions concerning the method of planning the programme. Dr. Southwell wished to know if Section G. were right in thinking that the majority of the younger members were men still in training and concerned with what might be described as engineering science rather than with engineering practice. He invited the younger members to make suggestions regarding next year's meeting. Broadly, the position was that there were four morning meetings at which there could be four main papers—if that were a good principle—leaving four hours for eight half-hour papers, with half an hour each morning for discussion. It would, of course, be desirable, if possible, to classify the short papers under certain subjects, but in practice the papers submitted were of a miscellaneous kind and required to be sorted out.

In the ensuing discussion, Mr. H. Swan expressed a preference for papers on the purely scientific side, but Mr. P. H. Baker held the opposite view, remarking that it was practical problems in which students needed training. He thought half the morning should be devoted to practical papers. Mr. Norrie thought the present division of the programme was a good one, but was of the opinion that, in addition, technical lectures should be given in the evenings or on the Saturday. Mr. I. R. Frazer endorsed Mr. Norrie's remarks.

X-RAY EXAMINATION OF BUTT WELDS.

The time available for the discussion of the question of the future organisation of the Section having been exhausted at this point, the chairman suggested that a meeting should be held on the following morning for further consideration of the question. This having been agreed to, Mr. W. D. Garrick was called upon to give his short paper on the X-Ray Examination of Butt Welds. The presentation of the paper, which will be reprinted in a subsequent issue of ENGINEERING, was followed by a brief discussion. Dr. Southwell, after thanking the author, asked what was the power of the X-ray apparatus used in the tests referred to in the paper. To this Mr. Garrick replied that the portable set illustrated employed a 250-kV tube and was capable of penetrating steel up to 3 in. in thickness in a reasonable time. He added that three or four sets in use in this country were operated at a million volts and could be used for examining steel 8 in. to 10 in. in thickness, while one set about to be put into service would be operated at two-million volts. Dr. Southwell remarked that in these cases, he presumed, the material would be taken to the set for examination, and the author replied that in most cases the specimen was taken to the apparatus, for considerations of safety. He added that while the apparatus was portable to a certain extent, it had to be operated in an area from which workmen could be more or less excluded. Mr. Norrie asked for further information on the stereoscopic method of locating faults, and the author explained that, for this purpose, lead markers were attached to the upper and lower surfaces of the specimen in the neighbourhood of the fault and X-ray photographs were taken with the rays directed at an angle on each side of the axis containing the fault. The markers and the fault appeared in both photographs and from their relative positions the fault could be located with the required accuracy. Referring to a statement in the paper that X-ray examination was the most successful form of non-destructive test, Mr. Norrie also inquired whether X-rays were not likely to be replaced by gamma rays. To this, Mr. Garrick replied that, while both gave rather similar results, X-rays gave better definition, though gamma-ray apparatus had the advantage of greater portability.

APPARENT YIELD STRENGTH OF PLAIN-CARBON STEEL.

The last item on the programme for the meeting was a paper by Dr. J. A. Pope giving an analysis of size and stress-distribution effects in the yield of plain-carbon steel. Little time remained for the presentation and discussion of the paper, and, owing to the lateness of the hour, the audience had dwindled to three or four members. The paper, however, will be reprinted in full in an early issue of ENGINEERING. Dr. Pope rapidly summarised his paper, referring only to the main points. A brief discussion between Dr. Southwell and Dr. Pope followed, but as this would be hardly intelligible without reference to a diagram in the paper, it would be useless to record it here.

The programme having been completed, the meeting terminated. In the afternoon, a party of members of Section G visited the Comrie Colliery, near Oakley, Fifeshire, and were able to see some of the underground plant, though it was not possible to visit the actual working face. Another party visited the works of the Logan Mining Machinery Company, Limited, at Lochee, near Dundee. As indicated above, the discussion on the future organisation of the engineering section was continued on the morning of Wednesday, September 3, but we are unable to deal with this.

AIRCRAFT-TESTING CHAMBER.

IN order to assist in solving the many problems encountered during the development of new designs of aircraft, Messrs. Vickers-Armstrongs Limited, Westminster, London, S.W.1, are constructing a large testing chamber at their Weybridge works. The chamber is now nearing completion and a recent photograph is reproduced as Fig. 1, on this page, which gives a good indication of its size. It is intended to reproduce in this chamber conditions of temperature and pressure likely to be encountered up to an altitude of 70,000 ft. in any latitude, and for this purpose special refrigeration plant is being installed, together with vacuum pumps, air-circulating fans and air-drying equipment. When the chamber is in operation it will be possible to mount the pressure cabin of an aircraft within it and test the pressurising and cabin-heating equipment under conditions likely to be encountered during flight; in addition, the behaviour of aircraft structures, control surfaces and engines may be observed under a variety of conditions.

The test chamber itself is in the form of a cylinder which has a diameter of 25 ft. and a length of 50 ft., the cylinder being closed at each end. It is built from steel plates having a thickness of $\frac{1}{4}$ in., and it is stiffened by external rings 6 in. deep by $\frac{3}{4}$ in. thick, which are spaced at intervals of 2 ft. throughout its length; additional stiffening is provided at each end by circumferential support girders having a flange width of 12 in. and a depth of 18 in. One end of the cylinder is sealed permanently, while the other end is fitted with a large door which is mounted on a two-directional carriage. This gives a movement of 12 in. away from the sealing face, which is effected by a 40-ton hydraulic jack incorporated within the door, and a movement of 45 ft. at right angles to the chamber centre line, which is obtained from a hand-operated winch built into the carriage structure. The circulating air is returned from one end of the chamber to the other through four ducts, two on each side of the chamber, and this arrangement is clearly visible in the illustration. The ducts are of circular cross-section, having a diameter of 6 ft. 9 in., and they are stiffened by external rings having a depth of $2\frac{1}{2}$ in. and a thickness of $\frac{5}{8}$ in., the distance between them being 16 in. A flexible expansion bellows is situated halfway along the length of each duct, the bellows being constructed from $\frac{1}{4}$ in. steel plate; each duct changes direction at each end through two right-angle bends. The total weight of steel contained in the chamber, the ducts and the door is 205 tons, while the volume of air enclosed in the chamber when the door is shut is about 40,000 cub. ft.

Two airlocks are situated at the fixed end of the main chamber for easy access. In addition, safety valves are provided at this point which can be operated in cases of emergency by a quick-release mechanism; these in turn are connected to a series of pressure-sensitive instruments placed at critical points in the structure under test. A number of manholes are incorporated in both the top and bottom surfaces of the chamber, the covers of which can be replaced by glass observation panels, special plates containing electrical leads or other similar items. The complete structure is supported at each end by steel cradles, the end adjacent the door being fixed to the cradle, while the other end rests on rollers to allow for either expansion or contraction movements. The differential expansion of the complete structure is catered for by the steel bellows fitted to the ducts to which reference has been made above. The structure has an overall length of 83 ft., the corresponding dimensions for breadth and height being 44 ft. and 32 ft., respectively. It is of welded construction throughout and was built at Vickers-Armstrongs Naval Yard, at Barrow-in-Furness, whence it was transported by road to its present site. The site on which the chamber has been erected is some 300 ft. from the permanent foundations and, when these are complete, it will be moved into position.

To produce the conditions of low temperature encountered at an altitude of 70,000 ft., a refrigeration plant is being installed. This will be carried out in two stages, the first of which will be capable of reducing the temperature to — 55 deg. C., while the second stage, which will be installed at a later date, will enable a temperature of — 70 deg. C. or even lower to be reached. The first stage of the cooling plant will consist of four quadruple-compound ammonia compressors, each of which will be driven by a 150 h.p. electric motor, the resulting total output being 360,000 B.Th.U. per hour at —50 deg. C. The evaporation of the liquid ammonia will cool a supply of methanol, and this, in turn, will be circulated at the rate of 20,000 gallons an hour through a series of 16 coolers situated in the right-angle bends of the ducts. Each cooler will consist of a number of special-section copper tubes, to which are soldered copper gill plates having a thickness of 16 gauge and a pitch of 1 in., and the total cooling surface presented will be in the neighbourhood of 20,000 sq. ft. The coolers will have a double function, as, in addition to refrigeration, they will serve as turning vanes for the circulating air.

Obviously, special attention will have to be paid to thermal insulation, and this will be effected by building a steel-framed shed which will enclose the unit, the length, breadth and height, at the eaves, of the shed being 85 ft., 46 ft., and 28 ft. 7½ in., respectively. The door at the end of the main chamber, however, will be provided with its own insulating shell. The walls and roof of the shed will be built from 12 in. thick insulating material, and in order to avoid the possibility of frost-heave occurring under the foundations, the floor of the insulating shed will be in the form of a light concrete platform supported by brick piers approximately 8 ft. above the main concrete foundations; the cellar thus formed will have free air circulation. The surface of the concrete platform will be covered with insulating material having a thickness of 12 in., while the area carrying the support cradles will be of an insulating material having a greater density and capable of carrying the imposed weight which will be in the region of 30 lb. per square inch. In order to reduce icing within the chamber, a plant for drying the air as it enters from the atmosphere will be installed; this will also condition the air outside the chamber but within the insulation covering.

Tropical conditions will be simulated by shutting down the refrigeration plant and boosting the air-circulating fans. Four fans will be fitted, one in each duct, and each fan will be driven through a bevel drive from an electric motor situated outside the chamber insulation. The fans will be of the four-bladed type while the motors will be 60 h.p., but rated up to 150 h.p. for short periods. The velocity of the air in the ducts will be 100 ft. per second. To simulate High-Altitude conditions a two-stage Nash-Hytor vacuum pump, driven by a 140-h.p. electric motor, will be installed. With the first stage working alone, the pump will be able to produce an absolute pressure of 18 in. of mercury, but with both stages in operation this figure will be reduced to 1⅛ in. of mercury. The time taken to reach the latter figure will be 90 minutes, which is equivalent to a rate of climb at sea level of 1,000 ft. per minute, but further pumps may be added at a later date to increase this figure.

With the exception of the second-stage refrigeration plant, which, for purposes of safety, will be isolated, the complete plant will be housed in a common building. This building will also contain the electrical sub-station, which will supply equipment totalling 1,750 h.p., but it is not expected that the peak load will exceed 900 h.p. It is hoped to have the complete plant running by the end of this year and, so far as is known, it is the largest of its kind, either in existence or projected.

THE LATE MR. A. D. MACKINNON.—We record with regret the death, on August 28, of Mr. Angus Dow Mackinnon, who was a member of the staff of the industrial-motor sales department of the British Thomson-Houston Company, Limited, Rugby. Mr. Mackinnon was born in Glasgow in October, 1887, and was apprenticed to the Caledonian Railway Company from 1903 until 1906, after which he studied at the Royal Technical College, Glasgow, for two years. He served a further apprenticeship of a year with Messrs. Mavor and Coulson, Limited, and then, from 1909 until 1911, took a course in the test department of the British Thomson-Houston Company, Rugby. He was then transferred to the alternating-current engineering department and joined the supply department in 1913. Mr. Mackinnon was sent to the firm's Glasgow district office in 1921, and was made manager of the Middlesbrough district office on January 13, 1930. On January 1, 1933, he took over, in addition, the management of the Newcastle-upon-Tyne district office. Owing to ill-health, he returned to Rugby and rejoined his old department (now the industrial-motor sales department) on September 1, 1936. At the time of his death he was engaged on work connected with synchronous electrical machinery.

THE "INDUSTRIAL WALES" EXHIBITION, LONDON.

THIS exhibition, which was opened at Olympia by Lord Portal, on August 28, was organised by the Industrial Association of Wales and Monmouthshire, a body representing all the important industries in that area. It was formed with the object of promoting trade and industry within the Principality and, with a membership of over 400, includes firms engaged in light, medium and heavy industry, commence, transport and public service. The exhibition was designed, therefore, to give a comprehensive picture of the various industrial activities which exist in Wales to-day, and to show the great developments which have taken place in this field during the past ten years. From a tour of the exhibition, which closes tomorrow, September 13, and an inspection of its many stands showing a very wide range of products, it is evident that the organisers have succeeded in their objects and have demonstrated the industrial achievements of the Principality in a convincing manner. With an exhibition of this nature, covering such a wide range of national activities, it is not possible to deal with the entire range of exhibits in detail, but a review is given of the main features to be found in the field of engineering and allied trades.

The importance of coal in the economic structure of Britain, and particularly so in the case of Wales, on whose coalfields its own industrial economy depends, is emphasised by the presence of the National Coal Board's stand. Fittingly, it occupies a prominent position in the exhibition to provide information concerning the basic industry of Wales, while, for general interest, a large working model of a colliery pit-head gear with screening plant is shown. Another prominent stand is that of the Board of Trade, which is playing a leading part in the establishment of new industries in the Welsh development areas. Many miscellaneous goods and products from Welsh factories are shown on this stand, which is available for the supply of information to prospective manufacturers who are considering production in Wales.

Of next importance to coal in South Wales is the heavy iron, steel and metal industry, and this branch is well represented by several leading firms. Messrs. Welsh Plate and Sheet Manufacturers, 12, Whitehall, London, S.W.1, makers of tinplate, terneplate and blackplate, have a stand showing specimens of their products, with examples of articles made therefrom, notably vitreous enamelled ware, for which blackplate is the basic material. The stand of Messrs. Guest Keen Baldwins Iron and Steel Company, Limited, East Moors Works, Cardiff, shows the application of steel to coal-mining equipment, and the company, who claim to be the largest producers of steel supports for underground mining, are exhibiting their "Splayed H" section arches and pit props. Examples of their products for underground railways are also shown. Messrs. Guest Keen and Nettlefolds, Limited, Castle Works and Rolling Mills, Cardiff, have a representative display of their products, including bars and sections, cold-rolled steel strip and wire nails, of which it is stated that the Cardiff works produce over 500 millions a week in all sizes and types. They also show a patented cast-iron plate sleeper, arranged for carrying a 95-lb. B.H. rail. The sleeper consists of two castings, one under each rail, and they are connected by steel or wooden tie-bars.

The products of the Whitehead group of companies are shown together on one large stand. This group comprises the Whitehead Iron and Steel Company, Limited, Newport; Messrs. Whitehead, Hill and Company, Limited, Newport; Messrs. W. A. Baker and Company, Limited, Westgate Foundries and Engineering Works, Newport; and Messrs. Godins (The Rollers of Steel Sections), Limited, Newport. Messrs. Whitehead Iron and Steel Company show a range of manufactures covering black and bright-drawn steel bars, hot and cold rolled steel hoop and strip, and reinforcing rods. Messrs. Whitehead, Hill and Company are exhibiting their primary product of mild-steel wire for industrial, agricultural and domestic uses, and also show some specimens of brick construction, made from the products of their brickworks at Llandowlais, Cwmbran, which are now being supplied for housing contracts. The exhibits of Messrs. Godins, Limited, cover a very wide range of cold-rolled sections. These sections, or formed shapes, can be produced from steel or any ductile metal in gauges from 8 S.W.G. to 30 S.W.G., and the firm also undertake the fabrication of light assemblies from such sections.

The stand of Messrs. Imperial Chemical Industries, Limited, Nobel House, 2, Buckingham-gate, London, S.W.1, is arranged to show the non-ferrous metal products of their factories at Waunarlwydd and Landore. The former factory specialises in aluminium strip, rod and extrusions, suitable for window sections, sinks and cabinets, and vehicle body-work, while the factory at Landore is devoted to the production and fabrication of copper and brass for heavy industrial applications, such as locomotive fireboxes, condenser tubeplates and copper process pans. Goulds Foundries, Limited, Vulcan Foundry, Cardiff, and Tredegar Foundry, Newport, are exhibiting a selection of bronze and iron castings for marine and general engineering purposes. The firm are licensees for Meehanite metal castings and can produce marine propellers up to 15 tons in weight. Messrs. The British Arc Welding Company (Bristol Channel), Limited, Cardiff, are also exhibiting at this stand, and the company has recently become licensed by Messrs. Under-Water Welders and Repairers, Limited, 26-27, St. James's-street, London, S.W.1, to operate in the Bristol Channel area on under-water welding and cutting work. Messrs. C. H. Bailey, Limited, dry-dock owners, ship repairers and engineers, of Newport, Cardiff and Barry, have a stand to illustrate the facilities offered by the firm at these ports. They are exhibiting a new process for the cold repairing of cracked and broken castings, which, under an American patent is known as Metalock; the operating company is in Canada. Briefly, the process consists of lacing together the cracked portions of a casting by a number of indented inlays formed from a special alloy. The number of inlays required for a specific job depends upon the extent of the damage and the stresses involved, but it is claimed that the resulting repair is pressure tight, when necessary, and that the need for the replacement of a broken piece of machinery is overcome. As welding is not used, pre-heating of the casting is unnecessary and internal stresses are avoided.

The stand of the Metal Box Company, Limited, The Langham, Portland-place, London, W.1, displays in great variety the plain and decorated containers which this company manufacture from tinplate, blackplate and aluminium. In addition to 25 other factories in the British Isles, the company has two factories at Neath and one at Clydach. An interesting working exhibit on the stand is a double-seaming machine for can making, made by one of the firm's works at Acton, London. After the iron and steel industries of Wales, probably the next in importance is the oil refinery plant owned by the National Oil Refineries, Limited, Britannic House, Llandarcy, Neath, and an exceptionally interesting model of the continuous counter-current cleaning plant for petrol, kerosene and lubricating oils at Llandarcy, is shown on their stand. The company is a subsidiary of the Anglo-Iranian Oil Company, Limited, London, and are engaged in the refining of crude oil, producing a range of products such as petrol, Diesel oils, lubricating oils, waxes and asphalts.

The lighter-engineering industries and shipping interests of Wales are well represented on the first floor of the exhibition. On the engineering side, the stand of Messrs. Rubery, Owen and Company, Limited, Wrexham, North Wales, a branch of the parent company of Darlaston, South Staffordshire, indicates the diverse products of the company; the Wrexham works will ultimately manufacture steel furniture, partitioning, safes and machined components for all engineering purposes. On the stand of Messrs. Aberdare Cables, Limited, Aberdare, Glamorganshire, are shown some typical products of this firm who manufacture high-tension and telephone cables. A core-insulating machine for telephone cables is also shown and demonstrations are given of the production of insulated material. The same stand is shared by Messrs. South Wales Switchgear, Limited, Blackwood, Monmouthshire, who are exhibiting examples of their high-tension switchgear, up to 11 kV, 250 MVA capacity, and a 200-kVA power transformer wound for 11,000 to 400 volts. A further display by this firm includes electric washing machines and cookers, which are in mass production at Blackwood Works. An associated company of the firm, Messrs. Rhymney Engineering Company, Limited, Rhymney, Monmouthshire, is showing a "Renco" driving head for a 26-in. wide coal-conveyor belt, the unit being driven by a 15-h.p. air motor.

The manufacture of domestic hollow-ware is in considerable evidence, and one of the firms specialising in this is Messrs. Cyril Kieft and Company, Limited, Bridgend, South Wales, who, in addition to showing aluminium hollow-ware, display a new type of door-lock. It is on the Yale principle, but the key is formed with projecting pegs, like a fork with short prongs. In addition to being self-locking on closing the door, the lock can be dead-locked by a quarter-turn of the key, when it cannot be turned by the usual knob, and remains locked until the key is again employed. The Machine Tools Disposal Department of the Ministry of Supply has a stand and the Royal Ordnance Factories are also represented. The latter show a pre-stressed concrete sleeper which is to be put into production, and also indicate the many ways in which material is being reclaimed from war stores, such as ammunition. Numerous other industries, such as those manufacturing clocks and watches, shoes, nylon and fancy goods, furniture, toys, and optical products are represented at the exhibition.

TESTS OF 132-KV PRESSURE CABLES.

MESSRS. BRITISH INSULATED CALLENDER'S CABLES, LIMITED, LONDON.

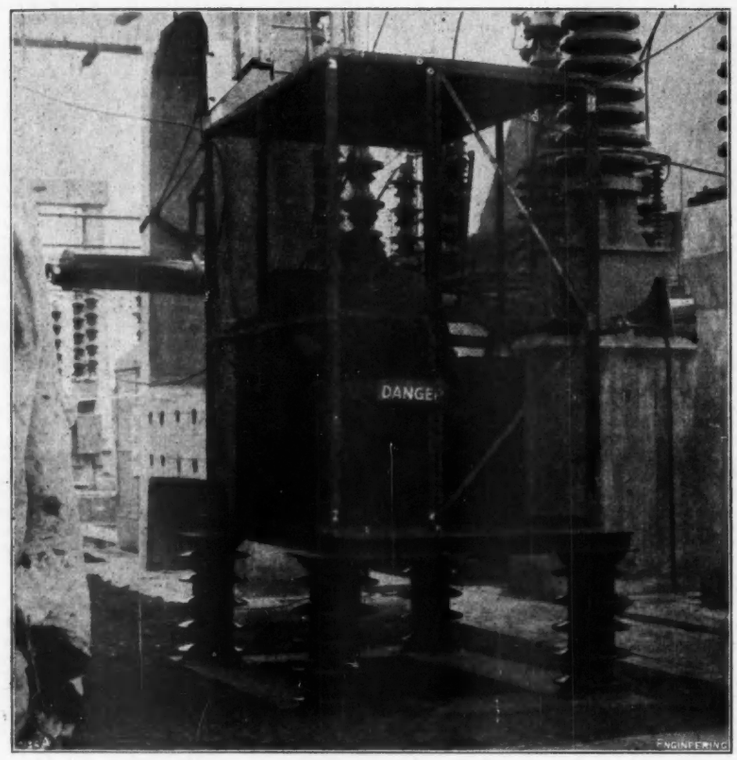
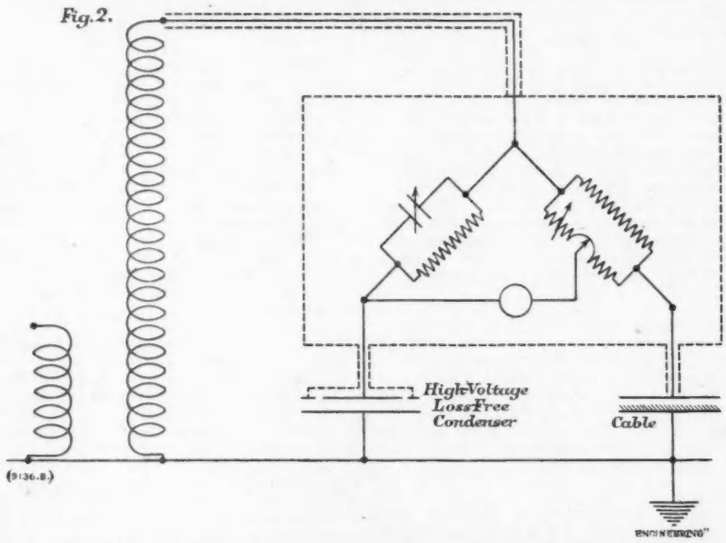


FIG. 1. FARADAY CAGE IN USE.

Fig. 2.



COURSES IN REFRIGERATION.—The second annual session of the course in the science and technology of refrigeration, established last year by the Institute of Refrigeration and the British Refrigeration Association, will commence at the Borough Polytechnic on Monday, September 15. It is a full-time course, lasting for six months, and it is open to students of National Certificate standard. The syllabus is identical with that for the entrance examination of the Institute of Refrigeration, and full particulars can be obtained from the Principal, The Borough Polytechnic, Borough-road, London, S.E.1.

THE CANADIAN PACIFIC CARGO LINER "BEAVERCOVE."—The new turbo-electric cargo liner Beavercove sailed from London on September 3 on her maiden voyage to Montreal, and the addition of this vessel to the fleet of the Canadian Pacific Railway Company, comprising the Beaverdell, Beaverglen and Beaverlake, which were built by Messrs. Lithgows, Limited, Port Glasgow, has enabled the Company to restore their freight service between London and Canada. The Beavercove is a single-screw vessel built by the Fairfield Shipbuilding and Engineering Company, Limited, Govan, Glasgow, and engined by Messrs. C. A. Parsons and Company, Limited, Heaton, Newcastle-on-Tyne, who supplied the turbo-electric machinery for the other ships. She is of 9,824 tons gross and has a deadweight capacity of 11,000 tons. Steam is supplied at a pressure of 850 lb. per square inch by a single main boiler of the Johnson type, and the double-unit propelling motor develops full power at 108 r.p.m., giving a service speed of 16 knots. The vessel has an overall length of 497 ft. 3 in., with a moulded breadth of 64 ft.; the accommodation for both officers and crew is amidships.

TESTS OF 132-KV IMPREGNATED PRESSURE CABLES.

A TEST embodying some unusual features was recently carried out on a 132-kV circuit at the Hams Hall B power station of the Birmingham Corporation. This circuit consisted of three 295-yard lengths of single-conductor 0·4 sq. in. impregnated gas-pressure cable of the type developed by British Insulated Callender's Cables, Limited, Norfolk House, Temple-place, London, W.C.2, and carries the output of one of the 50-MW generators shortly to be placed in commission. A similar machine will be ready in the near future, while a third is due for commissioning next year; both of these will have lengths of similar cable connected to them. The object of the test was to confirm the dielectric quality of the cables by site measurements. These measurements, it may be pointed out, are of great importance to both manufacturer and user as they provide the most satisfactory way of compiling reliable data on the dielectric condition of the cable installation as a whole. Moreover, when carried out periodically they enable any deterioration in the general insulation level to be detected and steps to be taken to safeguard vital circuits against breakdown.

A measure of this deterioration is the dielectric loss angle, determinations of which are usually made by means of a modified Schering-bridge circuit. With this arrangement, the cable to be tested may be regarded as a leaky condenser, and balance is obtained against a standard condenser of known value. The reason for this inversion is that when the conventional Schering-bridge circuit is employed for testing a buried cable it is necessary to apply correction factors involving the vectorial subtraction of dielectric losses in the leads from the test transformer and in the transformer itself, owing to the test capacitance being earthed on one side. The use of the inverted bridge arrangement, which is shown diagrammatically in Fig. 2, eliminates the need for these calculations and is simpler in practice. It possesses the disadvantage, however, that, as will be clear from the diagram, its use renders it necessary to raise all the components of the bridge to the test voltage. As adjustments must, of course, be made during the test, therefore, the ingenious course has been adopted of enclosing both the apparatus and the operator in a wire-mesh Faraday cage, which is mounted on high-voltage insulators. The operator, like the cable and instruments, is thus charged to the full test voltage while the measurements are being made, but all losses from the circuit, except those present in the actual cable installation under test, are excluded. This arrangement avoids the necessity for fitting long insulating handles to the apparatus and thus introducing stray capacity losses, which would affect seriously the conditions of balance. A view of the actual cage used in this test is given in Fig. 1. It was designed and constructed at the research laboratories of the British Insulated Callender's Cables, Limited, and was tested at voltages up to 100 kV to earth to ensure the safety of the operator from extraneous discharges.

The detector used in the bridge circuit is also of interest, since it consists of a three-stage battery-operated amplifier which is connected to a "magic-eye" tuning indicator. It is claimed that this arrangement gives a much higher sensitivity than the conventional vibration galvanometer used in Schering-bridge tests. The standard condenser employed is of the compressed-gas type with a capacity of 100 micro micro-farads when the gas pressure is 200 lb. per square inch. It is suitable for voltages up to 250 kV and was manufactured by Messrs. Gambrell Brothers and Company, Limited, 307, Merton-road, London, S.W.18.

As a preliminary check on the soundness of the insulation, the cables were first given the customary direct-current over-voltage test at 264 kV. Power-factor measurements were then taken at voltages between 10 kV and 76 kV to earth and consistent results of the complete installation, of which the cables form a part, were obtained on all three phases. As already indicated, these tests are intended to form a datum for tests which will be carried out periodically to ensure that the cables are maintained in good working order.

EXHIBITION OF BRITISH CHEMISTRY.—As part of the centenary celebrations of the Chemical Society, an exhibition, entitled "One Hundred Years of British Chemistry," is being held at the Science Museum, South Kensington, London, S.W.7. The exhibition, which has been arranged with the co-operation of the Chemical Society, the promoters of the Eleventh International Congress of Pure and Applied Chemistry, and the Department of Scientific and Industrial Research, is intended to illustrate the achievements of British chemists during the past century and to show the uses of chemistry in everyday life. The Museum is open from 10 a.m. to 6 p.m., on weekdays, and from 2.30 to 6 p.m. on Sundays. Admission is free, and the exhibition will remain open until September 30.

LAUNCHES AND TRIAL TRIPS.

MOTORSHIP.—Diesel-engined vessel, built by Messrs. A. and J. Inglis, Limited, Glasgow, for the Irrawaddy Flotilla Company, Limited. Gross tonnage, 100. Launch, August 5.

M.S. "PINTO."—Single-screw general cargo vessel, built and engined by Messrs. William Doxford and Sons, Limited, Pallion, Sunderland, to the order of Messrs. MacAndrews and Company, Limited, London. Main dimensions: 350 ft. by 50 ft. by 19 ft. 4 in. to second deck; deadweight capacity, 3,440 tons on a draught of 19 ft. Doxford opposed-piston five-cylinder oil engine to give a service speed of 15 knots. Trial trip, August 26.

M.S. "AQUITAINE."—Single-screw cargo vessel, with accommodation for 11 passengers, built by Messrs. Bartram and Sons, Limited, South Dock, Sunderland, to the order of the French Government, for management by the Compagnie Delmas Vieljeux, La Rochelle. Main dimensions: 410 ft. by 55 ft. 3 in. by 35 ft. 8 in. to upper deck; deadweight capacity, 6,950 tons on a draught of 24 ft. 8 in. Harland and Wolff-B. and W. six-cylinder oil engine of 5,250 brake horse-power, supplied by Messrs. John G. Kincaid and Company, Limited, Greenock, to give a service speed of 15 knots. Trial trip, August 26.

M.S. "SALAMANCA."—Single-screw cargo vessel, with accommodation for 12 passengers, built and engined by Messrs. Harland and Wolff, Limited, Belfast, for the Pacific Steam Navigation Company, Liverpool. Main dimensions: 440 ft. by 62 ft. 6 in. by 30 ft. 9 in.; gross tonnage, about 7,000. Harland-B. and W. eight-cylinder double-acting two-cycle oil engine. Launch, August 29.

S.S. "REGISTAN."—Single-screw cargo liner, with accommodation for 12 passengers, built, engined and boilered by Messrs. John Readhead and Sons, Limited, West Docks, South Shields, to the order of Messrs. Frank C. Strick and Company, Limited, London. Deadweight capacity, about 10,000 tons on a light draught. Triple-expansion engine with Bauer-Wach turbine and oil-fired boilers, to give a service speed of over 12 knots. Launch, September 1.

M.S. "PORT NAPIER."—Twin-screw refrigerated and general cargo vessel, built by Messrs. Swan, Hunter, and Wigham Richardson, Limited, Wallsend-on-Tyne, for the Port Line, Limited, London. Main dimensions: 525 ft. by 70 ft. by 43 ft.; deadweight capacity, 11,500 tons on a draught of 29 ft. 3 in. Two Wallsend-Doxford six-cylinder opposed-piston two-cycle oil engines supplied by Messrs. The Wallsend Slipway and Engineering Company, Limited. Trial trip, September 1.

S.S. "JUNELLA."—Single-screw trawler built by Messrs. Cochrane and Sons, Limited, Ouse Shipbuilding Yard, Selby, Yorkshire, for Messrs. J. Marr and Son, Limited, Fleetwood. Main dimensions: 167 ft. by 29 ft. by 15 ft. 3 in. Triple-expansion engine supplied by Messrs. Charles D. Holmes and Company, Limited, Alfred-street, Hull. Launch, September 2.

M.S. "SOUTHBANK."—Single-screw cargo vessel, built and engined by Messrs. William Doxford and Sons, Limited, Sunderland, to the order of the Bank Line, Limited (Messrs. Andrew Weir and Company), London. Main dimensions: 464 ft. 3 in. overall by 60 ft. by 29 ft. 3 in.; deadweight capacity, about 9,100 tons. Doxford five-cylinder opposed-piston oil engine, to give a service speed of 14 knots. Launch, September 2.

M.S. "LEMBULUS."—Single-screw tanker, built by Messrs. Swan, Hunter, and Wigham Richardson, Limited, Wallsend-on-Tyne, to the order of the Anglo-Saxon Petroleum Company, Limited, London. Main dimensions: 425 ft. by 54 ft. 3 in. by 40 ft. 6 in.; deadweight capacity, about 9,000 tons on a draught of 25 ft. Doxford-type three-cylinder opposed-piston two-stroke oil engine of 2,800 brake horse-power, supplied by the Wallsend Slipway and Engineering Company, Limited, to give a loaded trials speed of 12 knots. Launch, September 3.

S.S. "LOCH AVON."—Single-screw refrigerated and general cargo vessel, with accommodation for 12 passengers, built and engined by Messrs. Harland and Wolff, Limited, Belfast, for Royal Mail Lines, Limited, London. Main dimensions: 470 ft. by 66 ft. by 41 ft. to shelter deck; deadweight capacity, about 10,470 tons on a draught of 28 ft. 6 in. Parsons-type triple-expansion double-reduction geared turbines delivering 10,500 shaft horse-power. Trial trip, September 4.

S.S. "PACIFIC FORTUNE."—Single-screw refrigerated and general cargo liner, built by the Blythswood Shipbuilding Company, Limited, Scotstoun, Glasgow, to the order of Messrs. Norfolk and North American Steam Shipping Company, Limited (Managers, Messrs. Furness, Withy and Company, Limited, London). Main dimensions: 500 ft. by 63 ft. 6 in. by 41 ft. to upper deck; deadweight capacity, about 10,500 tons on a draught of 28 ft. 6 in. Parsons-type geared turbines and two Yarrow-type water-tube boilers, supplied by Messrs. John Brown and Company, Limited, Clydebank, to give a service speed of 15½ knots. Launch, September 4.

LABOUR NOTES.

As was generally expected, the Trades Union Congress, at Southport last week, did not take very kindly to the supplementary report of the General Council on the "economic crisis," especially to the paragraphs in it approving the idea of "a limited direction of labour." A number of the delegates expressed concern about safeguards for employees in any direction of labour, and Mr. Tewson, the general secretary of the Congress—who moved the adoption of the report—said that there were several points relating to that which the General Council desired to take up with the Government. Until decisions are reached on these points, therefore, the plans for the direction of labour may be said to be incomplete. A delegate of the Constructional Engineers' Union moved that the report be "referred back," and Mr. L. J. Callaghan, M.P., of the Inland Revenue Staff Federation, seconded. The report was, however, adopted by what was described as an "overwhelming majority."

In the course of a speech delivered earlier in the week, Mr. Isaacs, the Minister of Labour and National Service, said that he had decided to re-introduce a General Control of Engagement Order to ensure the better distribution of the labour force. The Government's aim, he went on, was to put the position right in a properly planned fashion, with the minimum of hardship, in the shortest possible time, to ensure that vital undermanned industries obtained the man-power they needed. It also intended to see the less-essential industries and services did not retain more man-power than was necessary, and to remove restrictive practices. To achieve all this it was necessary (1) To develop greater output per person employed; (2) to increase our total man-power resources; (3) to concentrate first on the essential tasks, even if that meant cutting out some less essential work which, though desirable in itself, just could not be carried in addition to the essential tasks.

Mr. Tanner, the President of the Amalgamated Engineering Union, moved a resolution suggesting that the Government should introduce early legislation making the establishment of Joint Production Committees a legal obligation on industry. Speaking for the General Council, Sir Joseph Hallsworth said that the value of joint production committees was appreciated, but there were dangers to be considered before asking that they be set up by law. It would be a pity, he added, if, by legalising them, they were set up in industries where trade unionism was weak. The resolution was referred to the General Council for full examination.

A resolution moved by another representative of the Amalgamated Engineering Union asked the Congress to instruct the General Council to seek the withdrawal of the National Arbitration Order on the ground that its war-time usefulness had passed. Sir Joseph Hallsworth suggested that instead of passing the resolution, the Congress should trust the General Council to seek the right moment for the removal of the Order. "In the stringent times ahead," he added, "employers will try to resist upward trends in wages. If we cannot resist employers we shall imperil standards, even in well-organised industries." Without voting on the resolution, the Congress remitted the matter to the General Council.

Professor P. M. S Blackett, of the Scientific Workers' Union, proposed that the General Council should do everything possible to bring about the freest publication of all industrial scientific research. Secrecy in this field, he said, led to overlapping and wasted effort, and was harming the production drive. It was feared that publication might tend to stultify research instead of encouraging it, and the matter was referred to the General Council for consideration.

According to returns received at the head office from branches, the membership of the Amalgamated Engineering Union was 805,846 at the end of July. This represented a decrease of 14,998 compared with the position at the end of June. During July, 4,435 members received sick benefit—a decrease of 403, and superannuation payments were made to 19,449 members—an increase of 113. Unemployment benefit was paid to 1,287 members—an increase of 192, and the total number of unemployed members was 3,895—a decrease of 167.

The Confederation of Shipbuilding and Engineering Trade Unions issued the following statement at Southport last week: "We have considered the request made by the Engineering and Allied Employers' National Federation for the institution of a "powerless" day in the engineering industry in certain districts which, if agreed to, would mean the working of four days of ten hours and one day of four hours, or, alternatively, four days of eleven hours. After reviewing the staggered-hours agreement entered into by the Ministry of Labour and National Service, the engineering employers, and ourselves, on June 20, we consider that the arrangements set out in that agreement for the staggering of hours, if worked, are satisfactory and will enable the requisite electricity load to be shifted, and production to be maintained. In these circumstances, we do not agree to the request made by the engineering employers in respect of the districts." The agreement on June 30 provides for a considerable extension of night working, and for Saturday work at normal rates where necessary.

The Standing Joint Committee of Working Women's Organisations states, in a communication issued last week, that it is willingly co-operating in the Government's campaign to recruit women for the undermanned industries. Every effort should be made, they say, to provide facilities, such as special shopping arrangements, school meals and play centres for school children, and the extension of canteen services to part-time employees. The additional women needed, it is pointed out, in several important industries must come largely from women at present outside the industrial field—in the main, married women with domestic responsibilities.

In Lancashire, where married women had always been employed in the cotton mills, more young women would return to the mills if there were adequate arrangements for the care of their children. "As the most likely source of additional women workers will be," the committee claim, "married women without children, and women whose children have reached school age or have left school, it is essential to override the prejudices which unfortunately exist in some firms against taking on 'older women'."

Under an agreement reached between the London Passenger Transport Board and the unions of members employed on the Underground Railways, wages are to be increased by 7*s.* 6*d.* a week and the working week reduced from 48 hours to 44 hours. Train men, station staffs, and booking clerks are to work 11 days a fortnight, having one week-day off every other week. Until new duty rosters are available, work in excess of the 44-hour week is to be paid for at overtime rates. The changes are to have effect as from June 30, and the wage increases and any arrears of payment of overtime rates in the ten weeks are to be paid in a lump sum. It is estimated that the cost to London Transport will be about 500,000*l.*

With the object of facilitating the spreading of the electricity load by means of staggered hours in factories, the Minister of Labour and National Service has issued a new Order under the Emergency Powers Act. This, the Factories (Hours of Employment in Factories using Electricity) Order, 1947, allows conditional exemption from some of the provisions of the Factories Act, restricting the hours of employment of women and young persons under 18. The Order comes into force on September 22, and allows a district Inspector of Factories to permit an earlier start or a later finish for day work which can begin at 6 a.m. (instead of 7 a.m.) or end at 11 p.m. (instead of 8 p.m.) for women and young persons under 18, and at 6.30 instead of 6 for those under 16.

Persons of 16 and over may work more than 48 hours a week but not more than 48 a week over two consecutive weeks or over a period which appears reasonable to the inspector. Work on Saturday afternoons is permitted, or on Sundays, provided that another day off is substituted. Women aged 18 and over and youths 16 and over may do night work not more than six nights a week, with a maximum of 48 hours a week and nine hours a night. They must not work more than 11 hours a night, and must not begin before 7 p.m. or finish after 8 a.m. A wide variety of arrangements for staggering working hours is allowed.

A meeting, on Sunday, of the miners who are on strike at Grimethorpe Colliery against the Coal Board's proposal that they should extend their stint, rejected, on a show of hands vote, the advice of Mr. W. Ernest Jones, secretary of the Yorkshire area of the Mineworkers' Union, and Mr. Tom Williams, who was once a miner and is now Minister of Agriculture, that they should go back to work and allow a fact-finding committee to examine the position. The strikers' contention was that the stoppage must continue until the Coal Board gives an undertaking that the increase in the stint will not apply in their case. As we go to press, however, it is reported that the men have decided to resume work on Monday next, on the old stint, pending a report of the fact-finding committee.

THE TESTING OF STRUCTURAL CONNECTIONS.*

By ARNOLD W. HENDRY, B.Sc., Ph.D.

SOME 25 years ago, the portal-frame girder was introduced for short-span bridges. The principle of this girder—really a type of arch—is now well known and is illustrated in Fig. 2. By making a rigid connection between the beam A B and column members C A and D B, and providing means for resisting the thrust H at the lower end of the columns, it is obviously possible to reduce the central bending moment in the beam. In suitable cases, considerable economies over the more conventional simply-supported girder, Fig. 1, can be effected, and the portal frame is of particular value where headroom is limited, due to the smaller depth of the beam. There are also a number of advantages from the æsthetic viewpoint and similar girders have been used for building frames with considerable success, largely due to the contemporaneous application of arc welding to structural steelwork.

When the portal-frame girder was first proposed, doubts were expressed about the stability of the knee joint. However, practice, backed by laboratory experiments, established the practibility of the design, although some uncertainty still remained as to the paths of the stresses at the knee and as to the best detail. With the object of investigating these points, experiments on portal-frame knees have been carried out in the Engineering Department of Aberdeen University.

The first tests were concerned with the stress distribution in various types of knees within the elastic range. To investigate this, three welded steel frames, 1, 2 and 3, particulars of which are given in Figs. 3 and 4, differing only in the design of the inner flange, were loaded in tension through pin-connections and the stresses in the frames were measured by means of an electrical resistance strain gauge. The electrical instruments used were of a simple nature, but capable of measuring strains to within two or three millionths of an inch per inch. The results of one of these tests (that on frame No. 2) are shown in Fig. 5, on this page, and are there compared with estimated values calculated by approximate methods. It was found that the stresses in the curved flange knees were considerably lower than those in the sharp cornered one and could be estimated fairly accurately.

As tests on steel frames using the electrical strain gauge are relatively expensive and laborious, further investigations were carried out by the photo-elastic method. Three small-scale flanged models were cut from "Catalin," a transparent plastic, and made to bear definite dimensional relations to the steel frames already tested. On testing these models, it was found that the stresses in them were closely proportional to those in the steel frames; the variation of the maximum shearing stresses in the web of the photo-elastic models with the size of the radius on the inner flange is indicated by the central curve in Fig. 6, while the corresponding values in the steel frames are shown by open circles. Other comparisons showed equally satisfactory agreement.

Having thus established the validity of the method, some other models were examined to study the effect of varying the length of the legs of the frame and to investigate the stresses in other shapes of knees. The curves of Fig. 6 refer to three different leg lengths, and from these experiments it was found that the web stresses at the knee depended almost entirely on the bending moment. The effect of web stiffeners on the stress distribution was also investigated by means of photo-elastic models; Figs. 7 and 8, on page 262, show, respectively, the fringe pattern and lines of principal stress in a stiffened model.

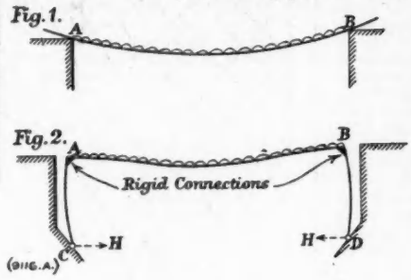
As a result of these tests, it was possible to draw conclusions of practical value in design. For example, it was shown that if a curved flange knee is adopted, in which the radius is about twice the depth of the member forming the leg of the frame, high web stresses at the knee are avoided and the flange stresses can be estimated accurately. Methods were also suggested for proportioning the welds connecting the web and flanges in such a knee.

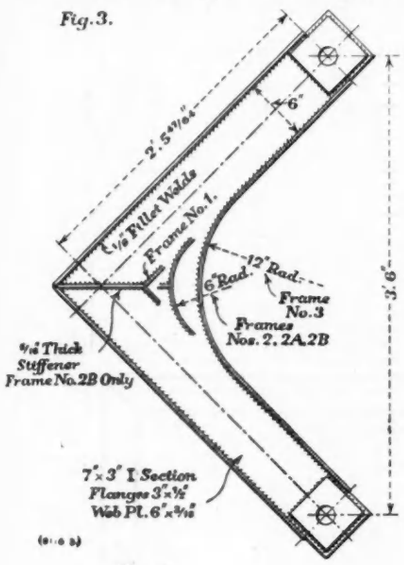
Although these tests afforded considerable data concerning the stress distribution in portal-frame knees within the elastic range, they gave little indication of the maximum loads which the connections would carry and of their behaviour after plastic yielding had commenced, particularly when subjected to compressive load. To investigate this aspect of the problem, further tests on steel frames were carried out. The frames were loaded in compression in a hydraulic testing machine, and, as an indication of the results obtained, tests on two of the frames will be described.

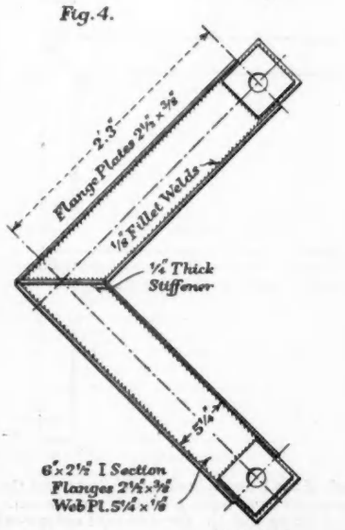
The frames were of similar design to Frame No. 2 in Fig. 3, but the second one had a $\frac{3}{16}$-in. thick diagonal stiffener; we may refer to these frames as Nos. 2A and 2B, respectively. The behaviour of the frames under test is conveniently studied by their load-deflection curves, which are shown in Fig. 9, page 262. The deflection of Frame No. 2A was proportional to the applied load until this reached about 4·5 tons. At this load, local yielding commenced in the welds connecting the curved flange to the web. Complete collapse of the frame, however, did not occur until the load had reached 8·45 tons. By this time, the inner flange had become plastic and failure of the frame was due to lateral deflection of the inner flange.

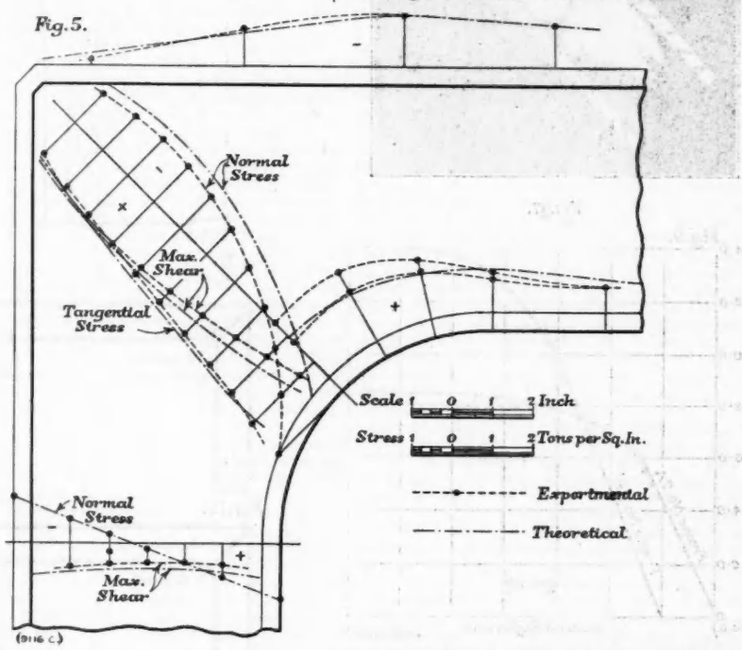
The load-deflection curve for Frame No. 2B deviated from its original straight line at 9·0 tons, due to the onset of plastic yielding in the curved flange and in the stiffener close to its connection with the inner flange. Collapse took place at 14·0 tons, when both the inner and outer flanges yielded; in this case excessive lateral deflection of the inner flange was prevented by the stiffener.

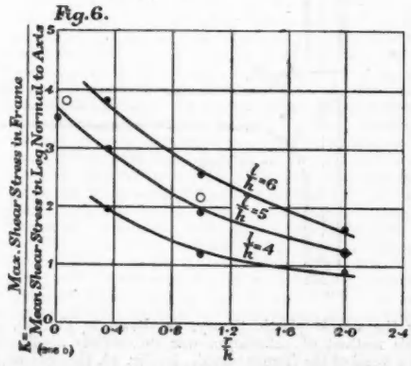
These tests are typical, in that unstiffened frames usually failed prematurely by lateral deflection of the inner flange, but further tests revealed that even comparatively light stiffeners were capable of providing











* Paper read before Section G of the British Association at Dundee, on Friday, August 29, 1947. (Abridged.)

TESTING STRUCTURAL CONNECTIONS.

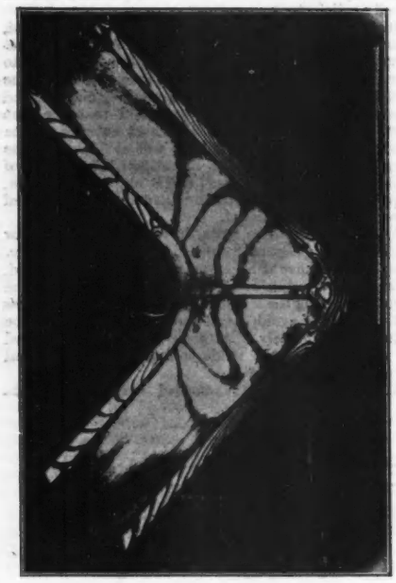


FIG. 7.

Fig. 8.

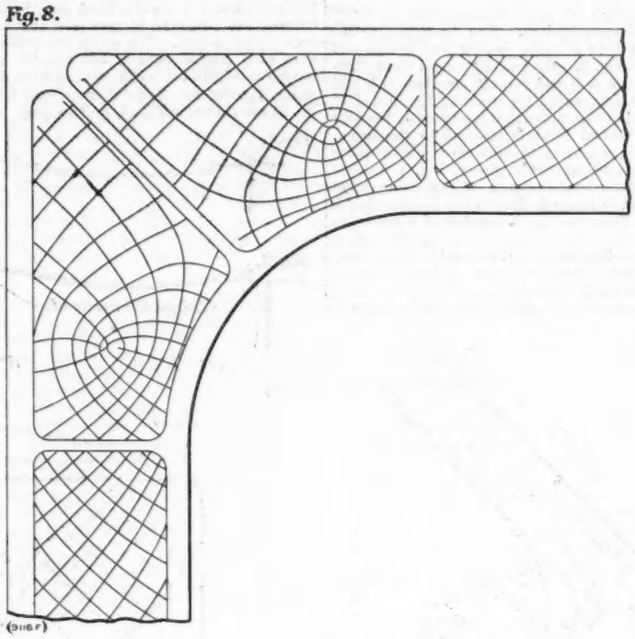


Fig. 9.

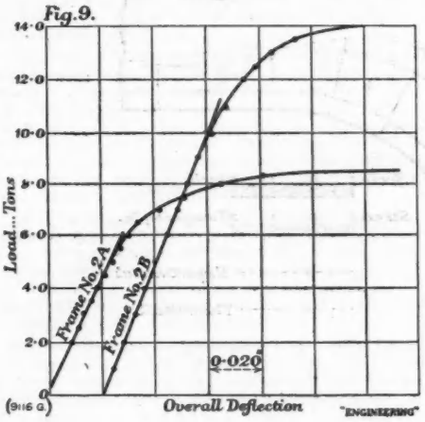


Fig. 10.

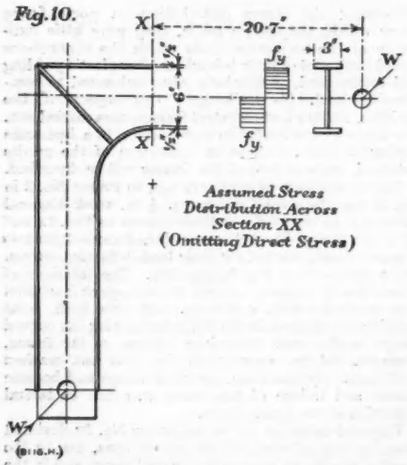


Fig. 11.

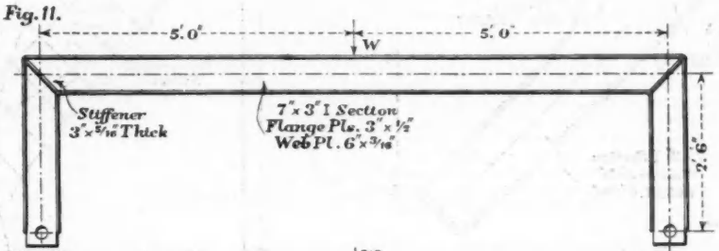


Fig. 12.

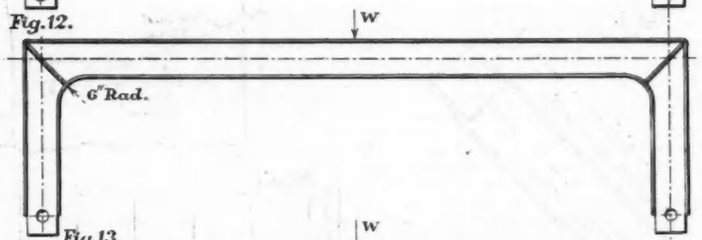
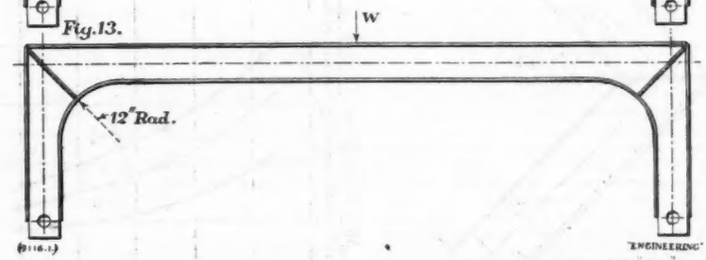


Fig. 13.



sufficient lateral restraint to prevent this type of failure and to allow the full strength of the members connected to be developed. Simple rules for proportioning the stiffeners were deduced from these tests. When the stiffening is sufficient to prevent failure by lateral deflection it is possible to calculate the strength of the knee with considerable accuracy, as collapse does not take place until the full strength of the weaker member connected is developed; this can be determined by the simple plastic theory, as shown in Fig. 10. This method of calculation was successfully applied to several of the frames tested. In Fig. 10, the critical section is X X. The plastic moment of section

$$M_p = (2 \times 3 \times 1{\cdot}5 \times 3{\cdot}25 + 2 \times 3 \times 0{\cdot}188 \times 1{\cdot}5) f_y = 11{\cdot}44 f_y.$$

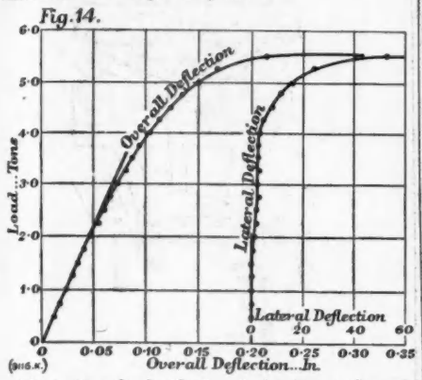
If the yield stress $f_y = 18$ tons per square inch, $M_p = 206$ in. tons. Value of load W on frame to produce this bending moment at section X X $= \frac{206}{0{\cdot}7 \times 20{\cdot}7} = 14{\cdot}2$ tons. Experimental value of collapse load $= 14{\cdot}0$ tons.

It is of interest to study the effect of the knee design on the strength of a simple portal frame. As an example we may consider the portals shown in Figs. 11, 12, and 13, which differ only in the design of the knee. The bending moment necessary to cause collapse of each of the knees is known from tests, and the plastic moment of the beam section is also known. It has been shown that the structure will collapse when the plastic moment has been developed at mid-span and when the collapse moment has been developed at the knee; on this basis, the collapse loads of the three frames have been estimated at 14·2 (100 per cent.), 16·0 (113 per cent.), and 18·8 tons (132 per cent.), respectively. From these figures the influence of the knee design on the strength of the frame will be appreciated. The percentage increase in strength obtained by putting a radius on the inner flange will, of course, vary from one case to another, depending on the loading and upon the dimensions of the frame.

It has been proposed that the plastic theory should be used in designing portal frames. As the method depends on estimating the collapse load of the structure, it is of some importance to know approximately what

variation in strength may be encountered in welded constructions produced under normal shop conditions. With this in view, twenty frames were made according to the design shown in Fig. 4 by ten different firms; in this way a representative sample of material and shop procedure was obtained. The frames were tested under compressive load, the deflection of the frame being recorded so as to enable the behaviour of the frame to be studied. A typical load-deflection curve is shown in Fig. 14, along with a lateral-deflection curve. As will be observed, the curve is linear up to a load of 2 tons, where the slope changes following the onset of plastic yielding in the stiffener close to the inner flange. The lateral deflection of the inner flange was negligible up to 4 tons, but began to increase more rapidly above this load, as by this time the stiffener was almost entirely plastic. Collapse took place at 5·54 tons, when both inner and outer flanges had yielded.

Fig. 14.



The test results for the twenty frames are shown in Table I. The collapse loads lay between 5 and 6·53 tons, with a mean value of 5·78 tons. A statistical analysis of the results showed that the probable error of

TABLE I. *Tests of Welded Frames.*

Frame No.	Load at First Yield.	Collapse Load.	Diff. of Max. Load from Av.
	Tons.	Tons.	
1	2·2	6·23†	+0·45
2	2·1	5·62†	−0·16
3	2·5	5·21	−0·57
4	2·2	5·64	−0·14
5	2·3	6·43	+0·65
6	2·3	6·53	+0·75
7	2·4	5·29	−0·49
8	2·1	5·69	−0·09
9	2·5	5·84	+0·06
10	1·8	5·74	−0·04
11	1·9	5·00	−0·78
12	2·0	5·16	−0·62
13	2·3	6·46	+0·68
14	2·1	6·50	+0·72
15	2·0	5·54	−0·24
16	2·1	5·95	+0·17
17	2·1	5·94	+0·16
18	2·1	5·94	+0·16
19	2·0	5·85	+0·07
20	—	5·20	+0·42

† Frames Nos. 1 and 2 were made from different materials; subsequent pairs were made from the same materials under the same conditions

the arithmetic mean was $\pm$ 0·07 ton, indicating that a fairly reliable average value had been established. An examination of the results will show that there is quite a wide variation in the strength of these welded frames, all nominally the same; the highest value was 6·53 tons and the lowest 5·00 tons, respectively 0·75 and 0·78 ton above and below the mean. Statistically, half of the results would lie within the range 5·78 $\pm$ 0·31 tons. It is clear, therefore, that great numerical precision in estimating the strength of a welded structure made under normal conditions is not to be looked for. Comparing the results of tests on pairs of frames made from the same materials and under the same shop conditions, we find that there may be an appreciable variation in strength even when these variables are excluded. In the table of results, each successive pair of frames was made from the same materials by the same manufacturer (excepting Frames Nos. 1 and 2).

In conclusion, it may be said that the experiments described in this paper represent an attempt to remove a number of uncertainties in the design of portal frames; the investigation is perhaps of interest as an illustration of the use of strain gauges, photo-elasticity, and destructive testing in advancing structural design.

MACINTOSH RUBBER WORKS, MANCHESTER.—The works started up in Manchester over one hundred years ago by Charles Macintosh, the rubber-industry pioneer, are to be rebuilt on the other side of Cambridge-street, subject to agreement on details with the City authorities.

PRE-CAST PRE-STRESSED CONCRETE RAILWAY BRIDGE.

A RAILWAY bridge the deck of which is formed of pre-cast and pre-stressed concrete beams, is illustrated in Figs. 1 to 4, on page 252. It is of particular interest in several ways. It is not wholly a new structure but replaces an old timber bridge, the Adam Viaduct, on the Manchester-Liverpool line of the London Midland and Scottish Railway, being situated between Wigan and Pemberton. The bridge carries two tracks to the railway company's Class I specification. It is 32 ft. 8 in. wide over the parapets and has four spans, each of approximately 30 ft. Of the old bridge, only the rock-faced abutments and the stone foundations for the piers were retained, though some minor modifications were necessary. In the new concrete bridge, the deck consists of concrete joist-section beams placed together side by side, as may be seen in Fig. 1, where they are viewed from the under side, and in Fig. 2, where part of the upper surface is visible. The beams are 32 in. deep, with a top flange 20½ in. wide and a bottom flange 16 in. wide. The vertical web is 4 in. thick in the central portion of the beam, but increases slightly in thickness towards the ends. There are 16 beams per span and these constitute the load-carrying structure, above which is a shallow concrete deck with ordinary sleepers and ballast. This gives continuity of track with the bridge approach lines.

The ordinary pre-cast concrete bridge has the drawback that the beams or units usually require to be of greater depth than when made from steel. This became apparent about 1934, when T-section concrete beams, which had been developed some ten years earlier, proved capable of being designed for spans up to 40 ft. It was economical and successful, as far as it went, but the considerable depth required often needed more vertical space than was available, so that, in many cases, the T-section beam could not be employed. The possibility of employing pre-stressed pre-cast concrete, which would enable smaller beams to be used, had been investigated before the outbreak of the recent war, but was not carried to a full conclusion. During the war, however, some pre-stressed pre-cast beams were manufactured for the Ministry of War Transport, for emergency employment in road bridges, and the experience gained suggested a further study of their use for railway underbridges. This showed that bridges could be reconstructed having pre-stressed beams with a shallower deck than with the ordinary type of reinforced concrete, the reduction in depth being of the order of 15 per cent. It was therefore decided to reconstruct an underbridge with pre-cast pre-stressed beams in order to determine the economy and specific advantages of this design. For various reasons it was not possible to carry out the work until 1946, when the renewal of the Adam Viaduct was undertaken.

At this point it may be of interest to explain the term "pre-stressing," as applied to bridge-deck beams of concrete. In the I-section beam, the stress under the normal working load is compressive in the top flange, and tensile in the bottom flange, with a neutral axis between the two. If a compressive stress can be induced in the area of the bottom flange beforehand, the two stresses cancel each other out to a certain extent, and the beam will carry a larger load, since the tension in the bottom flange due to the load can be considerably greater than is permissible in a normal beam. Conversely, pre-stressed beams may be made shallower than usual for a given load. To produce the initial compressive stress a special casting technique is necessary. In this a load is applied to the reinforcing rods in the lower flange before the concrete is poured, causing the rods to extend. The load is maintained until the concrete has set and is then released; and the consequent contraction of the rods applies a compressive stress to the concrete in which they are embedded.

The pre-stressing rods are formed from hard-drawn wire of 0·2 in. in diameter (about 5 S.W.G.) and of an improved patent steel having a guaranteed breaking strength of 100 tons per square inch. The rods run longitudinally through the beam in the bottom flange and the adjacent area. The secondary reinforcement, stirrups and binders, etc., are of ordinary mild steel. The casting bed is shown in Fig. 3. It consists of a paved concrete area approximately 900 ft. long, at each end of which is a mass-concrete abutment. The bottom forms for a row of beams, placed end-to-end with a spacing between each pair, are levelled on the casting bed. The heavy concrete abutment is provided with various steel structures, as shown in the foreground of Fig. 3; little of the abutment itself is visible above ground, though it may be inferred that it is wide enough to take three parallel rows of beams at a time. Only one row is being dealt with in Fig. 3. The steel structures support a vertical spacing plate, which determines the vertical and transverse positions of the pre-stressing wires. The wires passing through the spacing plate, after cleaning and straightening, are threaded through correspondingly-spaced holes in an anchor plate, each hole taking two wires. The anchor plate can be moved longitudinally and can be identified in Fig. 3, by the brush-like projection at its right, this consisting of the ends of all the pre-stressing wires. Each pair of wires is firmly secured to the anchor plate by a tapered plug driven into the hole concerned. When the wires have been secured, jacks are used, between the abutment structure and the anchor plate, to traverse the latter so that the wires are drawn taut and stretched by an amount that will give the pre-stressing force at a later stage. The anchor plate is then wedged up tightly.

The next stage is to complete the side and end forms for each beam, and then to insert the remainder of the reinforcements, stirrups, binders, etc. It is this penultimate stage of construction that is seen in the central portion of Fig. 3. When completed, the concrete can be poured, the pre-stressing wires being kept stretched during the operation. The concrete mix was designed to have a minimum crushing strength, on 6 in. cubes, of 6,000 lbs. per square inch in 28 days or 4,000 lbs. per square inch in 7 days using a special cement. The mix used was approximately 1 of cement to 3½ of fine aggregate, 30 per cent. of the latter being sand. The water-cement ratio was approximately 0·45. After pouring the concrete, external vibrators were used, internal-type vibrators not being available at the time the beams were manufactured. There was no difficulty in obtaining the specified concrete strength, and when this had been reached the actual pre-stressing of the beams commenced. The anchor plates, which, it will be remembered, were rigidly fixed to keep the wires taut, were then gradually released and the wires, contracting as the pull on them was reduced, set up the desired compressive stress in the lower part of the beam. This contraction naturally resulted in the "hogging" of the beam, when can be detected in the photograph from which Fig. 2 was reproduced. The pre-cast beams were left to cure, lying as cast, and may be compared to beads on a string since they were still all connected by the pre-stressing wires. When curing was completed, the wires were cut in the gaps and the finished beams were piled for storage as shown in Fig. 4. Bending tests were carried out on two of the beams by supporting them at the ends and applying at the centre a load equivalent to the designed load plus 50 per cent., that is, a concentrated load of 26¼ tons. The maximum deflection of one beam was ½ in. and of the other $\frac{7}{16}$ in. In neither case was there any permanent deflection, the beams returning to their original "hogged" condition on removal of the test load. There was no sign of cracking during the test.

It will be evident, in both Fig. 2 and Fig. 4, that the top flange of each beam was thickened in three places along its length by a "boss," a horizontal hole being cast in the centre of the boss and extending across the full width of the top flange. Long tie rods are threaded transversely through the group of beams. The rods are 1½ in. in diameter and are, of course, screwed at each end. The beams were laid as shown in Fig. 2, with narrow spaces between the top flanges. They were placed in position one by one, and two beams on each side were used to carry the parapet unit. When all the beams were in place, the spaces between them were grouted, and after a suitable setting time, the tie-rod nuts were tightened up by means of a torque-recording spanner. This operation gave a transverse stress to the group of units, so that they act as one under live load. The ballast was then placed in position, the new track laid and coupled up, and the bridge brought back into traffic after the week-end stoppages. The nature of the new piers will be clear from Fig. 1. They are 2 ft. thick by 28 ft. wide in the body and are increased in thickness at the foundations and the points of deck support. On the completion of the piers, portions of the temporary steel deck used after dismantling the timber bridge were removed and replaced with the pre-cast concrete beams during three week-end possessions. The pre-cast pre-stressed beams were manufactured at the company's pre-cast concrete depot at Newton Heath. The erection of the concrete beams and the construction of the permanent concrete piers was in the hands of Messrs. Leonard Fairclough Limited, 274, Terminal House, Grosvenor-gardens, London, S.W.1. The design and construction of the bridge was carried out by the Chief Engineer's Department of the London Midland and Scottish Railway, under Mr. W. K. Wallace, Chief Civil Engineer. The consultants for the design of the pre-stressed beams were Messrs. Pre-stressed Concrete Company, Limited, 38, Victoria-street, London, S.W.1.

CONTROL OF IRON AND STEEL.—The Ministry of Supply have issued the Control of Iron and Steel (No. 59) Order (S.R. and O., No. 1897, 1947, price 2*d*.). This amends maximum prices, the principal alterations being increases in the price of rain-water and soil pipes and fittings, roping wire and wire ropes. Maximum prices for extra light-weight screwed and socketed tubing are stated.

NOTES ON NEW BOOKS.

Plastics for Electrical and Radio Engineers. By W. J. TUCKER and R. S. ROBERTS. Second edition. The Technical Press, Limited, Gloucester-road, Kingston Hill, Surrey. [Price 15*s.* net.]

THE publication of a second edition of this book within two years of its first appearance is doubtless an indication of its merits, as well as of the rate at which developments are taking place in the use of plastic substances for high-frequency electrical insulation. In this latter respect, the fact that, within limits, plastics can be synthesised to have any desired properties is of great practical importance, and much of the additional matter in the new edition caters for recent advances in the technology of making and utilising low-loss plastics. Accordingly, the text devoted to high-frequency cables has been enlarged, while the various forms of silicone and polythene plastics are critically discussed in relation to the increased ranges of physical data that have become available recently. Apart from amplifications in these and other useful directions, the general structure of the book is substantially unaltered and comprises, as before, an instructive guide to the selection of the most suitable plastic substance for any of the multifarious purposes entailed in large-scale electrical equipment and commercial production, no less than in electronic devices and laboratory apparatus. The value of the book to engineers throughout this wide field is enhanced by the personal experience of both authors, and by their ability to present useful information simply and concisely.

Meter Engineering. By J. L. FERNS, B.Sc., A.M.I.E.E. Fourth edition. Sir Isaac Pitman and Sons, Limited, Parker-street, London, W.C.2. [Price 12*s.* 6*d.* net.]

IN his preface to this book, the author observes that no outstanding development in meters has been made since the publication of the third edition in 1938. This, however, is not wholly correct; there have been sundry developments by British designers since that date, some of which deserve notice. For instance, reference might be made to the use of binary alloys for temperature compensation with instantaneous operation; voltage compensation by new magnetic shunts, reducing normal voltage-variation errors to a negligible amount; new specification for meters wherein the usual overload improvements are now to be incorporated in the "working" curve of the meter, thereby giving greatly improved performance on the lower loads. The chapters on prepayment meters and summation metering could also be improved by being brought up to date. Despite these criticisms, however, Mr. Fern's book provides a useful survey of a particularly interesting branch of engineering.

The Law Relating to Building and Engineering Contracts. By W. T. CRESWELL, K.C., and NORMAN P. GREIG. Fourth edition. Sir Isaac Pitman and Sons, Limited, Parker-street, London, W.C.2. [Price 25*s.* net.]

As the law of contract is a part of the Common Law, it is almost entirely based on decided cases, so that the rules of law comprising the whole are necessarily deductions made from judgments in such cases. In this work the principles are first explained in simple, almost non-technical, language at the beginning of each chapter, or under each section-heading dealing with a sub-division of the chapter. The case or cases from which the principles have been deduced are then quoted, with references, and the pros and cons of each are set out; then, to complete the section, the relevant extract from the judgment is given. The reader is thus made familiar with a rule of law in the form of a principle supported by its case or cases, a mode of treatment which makes for easy learning by a student or for ready reference by a man of affairs. Indeed, for either reader the book is a complete compendium, as it includes an introductory chapter of definitions of terms, not only legal but of common use in engineering and building. The book includes some useful appendices comprising recommended standard forms essential as between contractor and purchaser, and the standard form of building contract recommended by the Royal Institute of British Architects, scales of professional charges, etc. In future editions the authors might note the complementary standard codes issued by the Institution of Civil Engineers and the Institution of Electrical Engineers, even if only by reference. The book is recommended to all who have the handling of contracts, as familiarity with its teaching would tend to obviate misunderstanding between parties and, consequently, possible litigation also.

CONTROL OF AMMONIUM SULPHATE.—The Control of Fertilisers (No. 35) Order, 1947, increases the charge which may be made for sulphate of ammonia, when delivery is made in bags containing less than 2 cwt., from 6*s.* 6*d.* to 8*s.* 0*d.* a ton.

"ENGINEERING" ILLUSTRATED PATENT RECORD.

ABSTRACTS OF SPECIFICATIONS RECENTLY PUBLISHED UNDER THE ACTS OF 1907 TO 1939.

The number of views given in the Specification Drawings is stated in each case; where none is mentioned, the Specification is not illustrated.

Where inventions are communicated from abroad, the Names, etc., of the Communicators are given in italics.

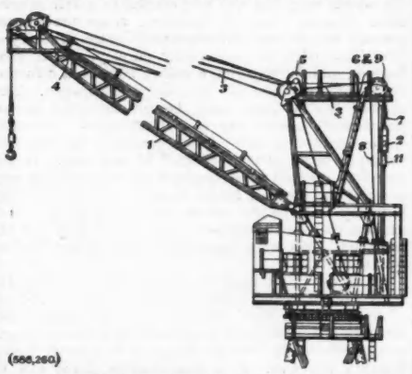
Copies of Specifications may be obtained at the Patent Office Sales Branch, 25, Southampton Buildings, Chancery-lane, London, W.C.2, price 1s. each.

The date of the advertisement of the acceptance of a Complete Specification is given after the abstract in each case, unless the Patent has been sealed, when the word "Sealed" is appended.

Any person may, at any time within two months from the date of the advertisement of the acceptance of a Complete Specification, give notice at the Patent Office of opposition to the grant of a Patent on any of the grounds mentioned in the Acts.

LIFTING AND HAULING APPLIANCES.

588,260. Jib Crane. Stothert and Pitt, Limited, of Bath, and W. C. Kindar, of Keynsham, Somerset. (5 *Figs.*) October 20, 1944.—This invention relates to an improved method of luffing jib cranes. In order to obtain luffing it is usual to provide a rope secured to the jib and passing over one or more pulleys anchored to the luffing barrel. To the latter is also secured the ballast rope which, passing over another pulley, is anchored to the ballast weight, actuation of the luffing barrel causing luffing of the jib through the intermediary of the jib rope and also operation of the ballast weight through its rope. In such an arrangement heavy frictional losses are set up due to the vertical reaction in the jib and ballast ropes. The invention provides a jib crane in which frictional losses during operation are minimised, so that the power necessary to luff the crane is reduced. The jib 1 is connected directly with a sliding ballast 2 through jib ropes 3 which are anchored at 4 to the jib and pass under pulleys 5 and



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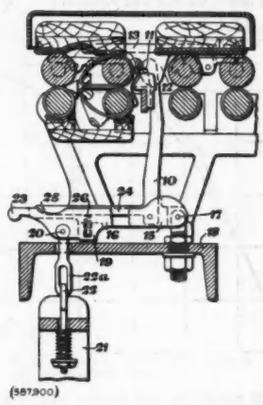
over pulleys 6 to be anchored to a bracket 7 secured to the sliding ballast box 2. The pulleys 5 are supported from the crane at a predetermined point, selected so that when the jib is luffed it is balanced at any radius between the maximum and minimum. The ballast box 2 is caused to slide by means of winch ropes 8, one end of each of which is anchored to the top of the ballast box 2 through an adjustable turnbuckle, the ropes passing over pulleys 9 down to the luffing-winch barrels and thence up to a spring compensating device. This device comprises a frame 11 secured to the ballast box 2 having attachments for the winch ropes 8, consisting of coil springs seated between plates and arranged to slide in the frame 11. This compensating device ensures equal rope loads and takes up all shocks when starting or stopping the luffing operation. When it is desired to luff the jib, the luffing winch is set in motion, to rotate the winch barrels and thus cause the ballast box 2 to be raised or lowered, due to the direct coupling of the jib 1 with the ballast box 2 through the jib ropes 3. (*Sealed.*)

TEXTILE MACHINERY

587,900. Weighting Motion for Drafting Rollers of Spinning Machines. Casablancas High Draft Company, Limited, of Manchester, and J. Noguera, of Manchester. (1 *Fig.*) October 3, 1944.—This invention provides an improved weighting motion for the drafting rollers used in preparatory and spinning machines, such as drawing frames, speed frames, ring frames and mules. The weighting hook 10 engages a transverse pin 11 secured between lugs 12 on the saddle 13. At its lower end, the hook 10 is pivoted between lugs 15 on the multiplying lever 16, which is hollow and substantially of U-section, and is pivoted at 17 on the roller beam 18. The multiplying lever 16 is formed with an abutment 19 between its pivoted end and the transverse pin 20 which supports the weight 21 by the hook 22 and link 22*a*, the abutment being adapted to rest on the roller beam 18. The multiplying lever 16 is mounted so that the end farthest from the fulcrum is towards the front of the machine, and is formed with a curved extension 23 to facilitate the lifting of the weight. An actuating lever 24 is rigidly connected to the hook 10 and is housed within the multiplying lever 16, the end 25 of the actuating lever being accessible at the front of the machine for manipulating the lever 24. The lever 24 can be lifted or depressed by the thumb of the operator to attach or detach the hook to or from the saddle. A device may be provided, if required, to ensure that the hook is detached from the saddle when the multiplying lever is lifted, consisting of a coil spring 26 housed in the lever 16, one end of the spring bearing upon the abutment 19 and the other end of the spring engaging the actuating lever 24. When the operator lifts the free end of the multiplying lever 16,



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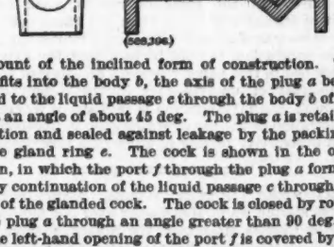
the hook is immediately detached from the saddle by the action of the spring 26 upon the actuating lever 24, and the abutment 19 can then be brought to rest on the roller beam. The top rollers are thus released from pressure and can be removed if desired. In order to re-apply the pressure, the multiplying lever is lifted and the actuating lever pressed down, so that the hook is re-engaged. The advantages of the invention are that, both in applying and releasing the pressure, only the front parts of the two levers need be touched and these are in a very accessible position. The space between the drafting rollers and the roller beam is kept free from encumbrances, so that undercleaners can be installed and can be put in and taken out without difficulty. A sufficiently heavy pressure can be applied simultaneously to all the top rollers with a relatively small actual weight, and only a small effort is necessary for attaching and detaching the hook. (*Sealed.*)

MISCELLANEOUS.

588,396. Full-Way Plug Cock. A. B. Jack, of Beeston, Nottingham. (3 *Figs.*) February 15, 1945.—This invention is a full-way round-port plug cock, which is more compact and lighter than the usual types. The plug, in addition to being inclined, is shortened in length and a compact form of glanded full-way plug cock is obtained by arranging that one opening of the port of the plug is made partly in the flat bottom and partly in the conical side of the plug, while the other port opening of the plug passes wholly through the conical side in the normal manner. When the plug cock is in the closed position, only this latter port opening is fully covered, but adequate cover is given to provide a tight shut off



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on account of the inclined form of construction. The plug *a* fits into the body *b*, the axis of the plug *a* being inclined to the liquid passage *c* through the body *b* of the cock at an angle of about 45 deg. The plug *a* is retained in position and sealed against leakage by the packing *d* and the gland ring *e*. The cock is shown in the open position, in which the port *f* through the plug *a* forms a full-way continuation of the liquid passage *c* through the body *b* of the glanded cock. The cock is closed by rotating the plug *a* through an angle greater than 90 deg., so that the left-hand opening of the port *f* is covered by the conical inner surface of the body *b* in which the plug is located. (*Accepted May* 21, 1947.)